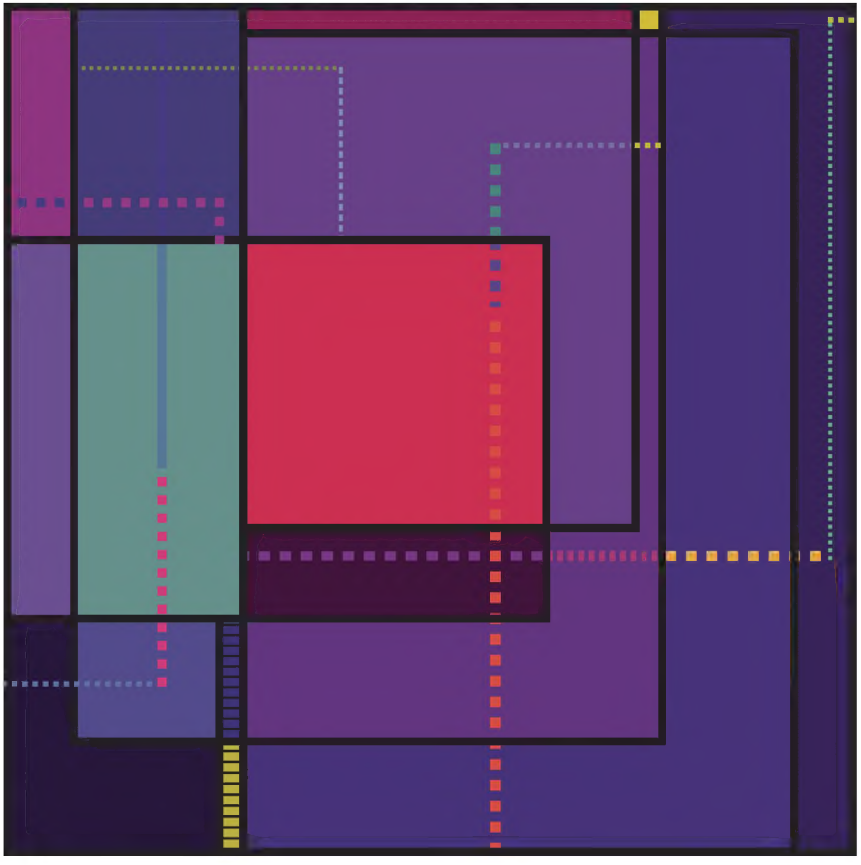
Apple Internet Router Administrator's Guide



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Apple Internet Router Administrator's Guide

Apple Computer, Inc.

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About This Guide

This guide explains how to install the Apple Internet Router Basic Connectivity Package and how to use the Router Manager application program. It provides information about setting up the router, configuring ports to create local area and wide area internets, monitoring and troubleshooting router operation, and planning your internet.

What this guide contains

The chapters of this guide contain the following information:

- Chapter 1, "The Apple Internet Router," provides a brief introduction to the family of products that constitute the Apple Internet Router, including the Basic Connectivity Package, the AppleTalk/IP Wide Area Extension, and the AppleTalk/X.25 Wide Area Extension.
- Chapter 2, "Installing the Basic Connectivity Package," provides information about the system requirements for the Apple Internet Router and explains how to install the router software included in the Basic Connectivity Package on a startup disk, and select a user port and a zone for the router.
- Chapter 3, "Setting Up the Apple Internet Router," explains how to use Router Manager to create a setup document, configure the router for startup, specify an administrator's password, and start the router.
- Chapter 4, "Configuring an AppleTalk Port," provides instructions for configuring the router as a seed router or as a nonseed router, configuring a LocalTalk port, configuring an EtherTalk or TokenTalk port, and hiding devices on an internet.

- Chapter 5, "Half-Routing," defines half-routing; and explains how to set up a half-routing port to originate a connection, answer to establish a connection, or call back to establish a connection.
- Chapter 6, "Tunneling Through Foreign Network Systems," defines tunneling.
- Chapter 7, "Configuring the Wide Area Routing Options," provides information about configuring options for a half-routing or tunneling port.
- Chapter 8, "Modifying the Router's Setup," explains how to change the router's zone; enter, change, or remove the administrator's password; activate and deactivate ports; stop the router; modify the port configurations in a setup document; use a different startup document; change the router's other startup options; and customize your view of a setup window.
- Chapter 9, "Monitoring the Router," explains how to use Router Manager to monitor network routing information, and router and port statistics—including routing activity, and network reliability and error rates—when the router is running.
- Chapter 10, "Troubleshooting," provides a troubleshooting checklist; explains how to use the Router Log; describes some problems that you might encounter with a network, a local or wide area internet, or the Apple Internet Router—including their symptoms, causes, and solutions; and provides additional information about recovering from errors while using Router Manager.
- Appendix A, "Planning Your AppleTalk Internet," provides guidelines for planning an internet—including evaluating your needs, planning the internet's physical layout, choosing a network-numbering scheme, specifying a network range, and dividing the internet into zones.
- Appendix B, "The Router Manager Program," describes the menus and commands of Router Manager, and provides cross-references to the task sections that explain how to use the commands.
- The glossary defines terms related to the AppleTalk network system, internet routing, and wide area networking.

You can purchase two extensions to the Apple Internet Router separately from the Basic Connectivity Package—the AppleTalk/IP Wide Area Extension and the AppleTalk/X.25 Wide Area Extension. The guides for these extensions include chapters on installation, port configuration, and troubleshooting.

What you need to know

The *Apple Internet Router Administrator's Guide* assumes that you are familiar with Macintosh System 7, including file sharing, the Network control panel, and the Chooser. For information about using the Macintosh or System 7, refer to the manuals that came with your computer or with your System 7 upgrade kit. To use this guide successfully, you should also understand basic AppleTalk networking and routing concepts. Experience in network administration is helpful.

Learning paths

This guide supports the information requirements of both novice and experienced network administrators. The best learning path for you to follow depends on your experience.

- If you are new to network administration, read Appendix A, "Planning Your AppleTalk Internet," and background information that precedes task instructions. Then, follow the task instructions. If you encounter a term with which you are unfamiliar, refer to the Glossary.
- If you are an experienced network administrator, but are setting up an Apple Internet Router for the first time, read the background information about internet routing and wide area routing provided in this guide. Generally, you can simply follow the task instructions.
- If you have previously installed version 2.0 of the AppleTalk Internet Router, be sure to read the section "Upgrading from the AppleTalk Internet Router Version 2.0" in Chapter 2 before installing the Apple Internet Router. Much of what you learned about setting up and monitoring a router using the Router desk accessory (DA), included with version 2.0 of the AppleTalk Internet Router, applies to the Router Manager application program, included with the Apple Internet Router. Reading Appendix B, "The Router Manager Program," will help you to transfer your knowledge of the Router DA to Router Manager. Also, read the task instructions and the chapters about wide area routing, which is new to the Apple Internet Router.

Getting help

Router Manager includes Balloon Help. Balloons provide on-screen descriptions of the items on the Macintosh screen. To turn on Balloon Help, choose Show Balloons from the Help (?) menu. Subsequently, when you point to an item on the screen, a balloon that explains the item's use appears beside the item. To turn off Balloon Help, choose Hide Balloons from the Help menu.

For more information

The following publications from Apple Computer provide additional information about AppleTalk networks:

- The *AppleTalk Network System Overview* provides a technical introduction to the AppleTalk network system and its protocol architecture. Published by Addison-Wesley Publishing Company.
- The *AppleTalk Remote Access Modem Scripting Language Guide,* which is included in the AppleTalk Remote Access Modem Toolkit, provides information about writing modem scripts. Available from APDA.
- *AppleTalk Update-Based Routing Protocol: Enhanced AppleTalk Routing* is a technical reference that provides detailed information about the AppleTalk Update-based Routing Protocol (AURP) and wide area routing. Available from APDA.
- *Inside AppleTalk,* second edition, is a technical reference that describes the AppleTalk protocols in detail. Published by Addison-Wesley Publishing Company.
- *Planning and Managing AppleTalk Networks* provides in-depth information for network administrators about planning and managing AppleTalk networks—including AppleTalk terms and concepts, and information about network services, media, topologies, security, monitoring and optimizing network performance, and troubleshooting. Published by Addison-Wesley Publishing Company.
- *Understanding Computer Networks* provides an overview of networking—including basic information about protocol architectures, network media, and topologies. Published by Addison-Wesley Publishing Company.

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1 The Apple Internet Router

The Apple Internet Router consists of a family of AppleTalk Phase 2–compatible routing products that support both local area and wide area networking. This chapter provides a brief introduction to the products that are components of the Apple Internet Router: the Basic Connectivity Package, the AppleTalk/IP Wide Area Extension, and the AppleTalk/X.25 Wide Area Extension. You can purchase these products separately.

The Basic Connectivity Package

The Basic Connectivity Package provides router software that allows you to connect two or more AppleTalk networks to create an *internet,* in which connected networks retain their separate identities.

The Basic Connectivity Package includes the Router Manager application program, which allows you to create setup documents, configure ports on the router, configure the router for startup, control and troubleshoot router operation, and monitor network performance. For detailed information about Router Manager, see Appendix B, "The Router Manager Program."

Using the Basic Connectivity Package, you can configure three types of AppleTalk ports—LocalTalk, EtherTalk, and TokenTalk—and *half-routing ports,* which provide connectivity to remote AppleTalk local area networks (LANs) over point-to-point links that consist of modems communicating over standard or leased telephone lines.

The AppleTalk/IP Wide Area Extension

With the AppleTalk/IP Wide Area Extension, you can extend the capabilities of the Apple Internet Router. The AppleTalk/IP Wide Area Extension allows two or more AppleTalk networks or internets to communicate through a tunnel built on a TCP/IP network. This router extension provides an IP Tunnel access method for an Ethernet or Token Ring port on the router Macintosh.

For general information about tunneling, see Chapter 6 of this guide, "Tunneling Through Foreign Network Systems." For information about configuring an IP tunneling port, see *Using the AppleTalk/IP Wide Area Extension,* included when you purchase the extension.

The AppleTalk/IP Wide Area Extension is available from authorized Apple resellers. To order the AppleTalk/IP Wide Area Extension, request Apple order number M8112Z/A.

The AppleTalk/X.25 Wide Area Extension

The AppleTalk/X.25 Wide Area Extension also extends the capabilities of the Apple Internet Router. The AppleTalk/X.25 Wide Area Extension allows two or more remote AppleTalk networks or internets to communicate over a point-to-point link using X.25 protocols. A *point-to-point link* is a type of half-routing link. This router extension provides an X.25 access method for a physical port that corresponds to an Apple Serial NB Card installed in the router Macintosh.

For general information about half-routing, see Chapter 5 of this guide, "Half-Routing." For information about configuring an X.25 port to establish a half-routing link between remote AppleTalk networks or internets, see *Using the AppleTalk/X.25 Wide Area Extension,* included with the extension.

The AppleTalk/X.25 Wide Area Extension is available from authorized Apple resellers. To order the AppleTalk/X.25 Wide Area Extension, request Apple order number M8111Z/A.

2 Installing the Basic Connectivity Package

This chapter provides information about the system requirements for the Apple Internet Router. It also explains how to install the router software included in the Basic Connectivity Package on a startup disk, and how to select a user port and a zone for the router.

System requirements

You need the following system components to install the router software included in the Basic Connectivity Package and establish communication over an AppleTalk internet:

- system software version 7.0 or later
- an Apple Macintosh Plus or later model Macintosh computer with at least four megabytes (MB) of random-access memory (RAM) installed
- a hard disk
- an installed network cabling system
- if the router Macintosh has an Ethernet port, EtherTalk version 2.5 or later, which you can install using the Installer disks
- if the router Macintosh has a Token Ring port, TokenTalk version 2.5 or later, which you can install using the Installer disks

△ **Important** You can use the Apple Internet Router only on internets in which *all* routers are compatible with AppleTalk Phase 2.

Running the router software on a Macintosh Portable or on a Macintosh PowerBook computer is not recommended. △

To obtain the best possible router performance, install the router software on a Macintosh computer with a microprocessor that runs at a fast clock frequency.

Depending on the level of performance required on your internet, you can use the Apple Internet Router as either a dedicated or nondedicated router. A *dedicated router* runs on a computer on which no other network services reside and no other application programs are running, and provides better performance. A *nondedicated router* runs on a computer that is providing other network services concurrently. If the router will typically handle high levels of internet traffic, you should configure the router Macintosh to function as a dedicated router.

Installing the router on a startup disk

This section describes how to use the Installer to install the router software included in the Basic Connectivity Package on the current startup disk of a Macintosh. The current startup disk *must* be a hard disk on which you have already installed System 7 or a later version of system software.

The Apple Internet Router Basic Connectivity Package includes three disks, the *Apple Internet Router Basic Connectivity Installer 1, 2,* and *3.* Before installing the router software, you should lock the *Installer* disks, then make backup copies of the disks. Lock your backup disks, then use them to install the router software. Set the original *Installer* disks aside for use in the event that your backup disks become damaged.

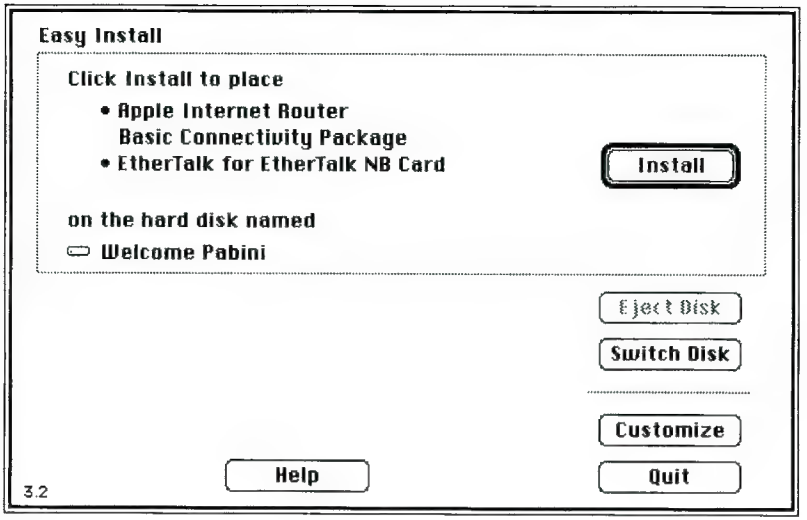
To install the router software for the ports that are available on the router Macintosh, follow these steps:

1 **Insert the *Installer 1* disk into a floppy disk drive and double-click the *Router Installer 1* icon to open it.**

The Installer icon is in the window that appears.

2 **Double-click the Installer icon to open the Installer program.**

The Easy Install dialog box appears. The contents of the list of software that the Installer will place on the hard disk depends on the model of the Macintosh computer or the network interface cards installed in the Macintosh.



3 Make sure that the hard disk on which the Installer will place the router software is the startup disk. If another hard disk is currently selected, click the Switch Disk button until the name of the startup disk appears.

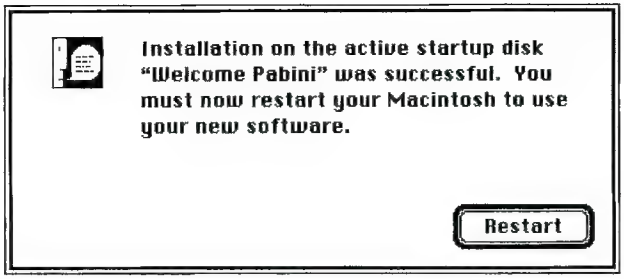
4 Click Install to place the listed software on the startup disk.

The Installer begins installing the router software on the startup disk. On-screen messages report the progress of the installation and ask you to insert the *Installer 2* disk, then the *Installer 3* disk, and finally, to reinsert the *Installer 1* disk.

You can cancel the installation at any time, leaving the startup disk unchanged.

If other application programs are currently running on the Macintosh, a message informs you that the Installer cannot install the router software on the startup disk while other application programs are running. To quit other open programs automatically and install the router software, click Continue. If you do *not* want to quit other open programs and install the router software at this time, click Cancel. The startup disk will remain unchanged.

5 When you see a message reporting that the installation was successful, click Restart.


Installation on the active startup disk "Welcome Pabini" was successful. You must now restart your Macintosh to use your new software.
Restart

As shown in Figure 2-1, installing the router software adds a status indicator to the Network control panel that indicates whether the router is currently on or off, and whether the router will start automatically when you next start up the router Macintosh.

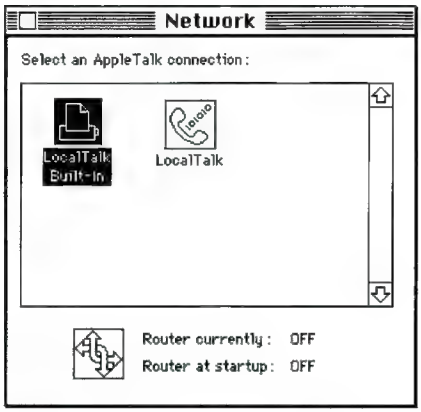


Figure 2-1 The status indicator in the Network control panel

Customizing your installation

To customize your installation of the router software, follow these steps:

1. Insert the *Installer 1* disk into a floppy disk drive and double-click the *Router Installer 1* icon to open it.

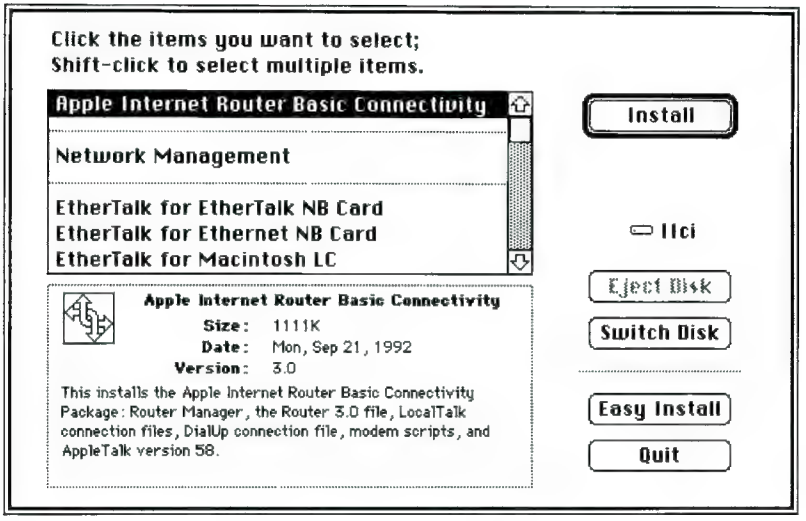
2. Double-click the Installer icon to open the Installer program.

   The Easy Install dialog box appears.

3 Make sure that the hard disk on which the Installer will place the router software is the startup disk. If another hard disk is currently selected, click the Switch Disk button until the name of the startup disk appears.

4 Click Customize to select specific software options for installation.

The Customize dialog box shown in the following figure appears. It lists all of the software options available for installation.


Click the items you want to select;
Shift-click to select multiple items.
Apple Internet Router Basic Connectivity
Network Management
EtherTalk for EtherTalk NB Card
EtherTalk for Ethernet NB Card
EtherTalk for Macintosh LC
Apple Internet Router Basic Connectivity
Size: 1111K
Date: Mon, Sep 21, 1992
Version: 3.0
This installs the Apple Internet Router Basic Connectivity Package: Router Manager, the Router 3.0 file, LocalTalk connection files, DialUp connection file, modem scripts, and AppleTalk version 58.
Install
IIci
Eject Disk
Switch Disk
Easy Install
Quit

5 Select "Apple Internet Router Basic Connectivity" from the list to install the Apple Internet Router, then Shift-click any additional items that you want to install.

If the router Macintosh has an Ethernet port, you must also select EtherTalk. If it has a Token Ring port, you must also select TokenTalk.

6 Click Install to place the selected software on the startup disk.

The Installer begins installing the router software on the startup disk. On-screen messages report the progress of the installation and ask you to insert other disks as necessary.

You can cancel the installation at any time, leaving the startup disk unchanged.

If other application programs are currently running on the Macintosh, a message appears, informing you that the Installer cannot install the router software on the startup disk while other application programs are running. To quit other open programs automatically and install the router software, click Continue. If you do *not* want to quit other open programs and install the router software at this time, click Cancel. The startup disk will remain unchanged.

7 **When you see a message reporting that the installation was successful, click Restart.**

Upgrading from the AppleTalk Internet Router version 2.0

If version 2.0 of the AppleTalk Internet Router is already on the startup disk, follow these steps when installing the router software:

1 **To open the Router desk accessory, choose Router from the Apple (🍎) menu.**

If the Router Setup window was open when you last closed the Router DA, the Router Setup window appears.

2 **If the Router Setup window does not appear, choose Router Setup from the Router menu to open it.**

3 **If the router is running, click the Current Status Off button in the Router Setup window to stop the router.**

You *must* stop the router before installing the Apple Internet Router.

4 **If the Restart Status On button is currently selected, click the Restart Status Off button to prevent the router from starting when you start up the router Macintosh.**

5 **Close the Router Setup window.**

An alert box appears, requesting you to save the changes that you made to the router setup.

6 Click Yes to save your changes to the router setup.

7 Insert the *Installer 1* disk into a floppy disk drive and double-click the *Router Installer 1* icon to open it.

8 Double-click the Installer icon to open the Installer program.

The Easy Install dialog box appears.

9 Make sure that the hard disk on which the Installer will place the router software is the startup disk. If another hard disk is currently selected, click the Switch Disk button until the name of the startup disk appears.

10 Click Install to place the listed software on the startup disk.

The Installer begins installing the router software on the startup disk. On-screen messages report the progress of the installation and ask you to insert other disks as necessary.

You can cancel the installation at any time, leaving the startup disk unchanged.

If other application programs are currently running on the Macintosh, a message appears, informing you that the Installer cannot install the router software on the startup disk while other application programs are running. To quit other open programs automatically and install the router software, click Continue. If you do *not* want to quit other open programs and install the router software at this time, click Cancel. The startup disk will remain unchanged.

11 When you see a message reporting that the installation was successful, click Restart.

Installing the Apple Internet Router renames version 2.0 of the AppleTalk Internet Router as *Router 2.0*. To use the router setup that you created for version 2.0 of the router, open Router 2.0 as a setup document.

Connecting networks to the router

Depending on the ports that are present on the router Macintosh, you may be able to connect LocalTalk, Ethernet, and Token Ring networks.

▲ **Warning** Shut down the router Macintosh before connecting a network to any of its ports. If you connect any type of network other than a LocalTalk network to the router Macintosh while it is on, you may damage the computer or the network interface card to which you are connecting the network. If you connect a LocalTalk network to the router Macintosh while it is on, the router Macintosh assigns itself a node identifier (node ID) without verifying that no other device on the network is currently using that node ID. If more than one device on a network has the same node ID, other devices on the network cannot access either device until one of the devices is switched off, then on again. ▲

The model of Macintosh computer used as a router determines the number of AppleTalk networks that you can connect directly to the router. The modem and printer ports on the router Macintosh enable you to connect two LocalTalk networks. If the router Macintosh has a built-in Ethernet port—for example, a Macintosh Quadra—you can connect an Ethernet network to that port. The expansion slots in the router Macintosh and the network interface cards installed in them enable you to connect additional networks. The Apple Internet Router software allows you to connect a maximum of 32 networks directly to the router. See the manuals that came with the computer for information about the ports and the number of expansion slots available on the router Macintosh.

If the router Macintosh does not have a built-in Ethernet port, you must install a network interface card—such as an Apple Ethernet NB Card or an Apple Ethernet LC Card—in the router Macintosh to connect an Ethernet network to the router. You must install an Apple Token Ring 4/16 NB Card in the router Macintosh to connect a Token Ring network to the router. For information about any of these network interface cards, refer to the manual that came with the card.

Connecting a LocalTalk network to the router

A router Macintosh has two *serial ports*—the printer port and the modem port. Generally, you should connect a LocalTalk network to the *printer port* on the router Macintosh. However, when connecting a second LocalTalk network to the router, you can use the *modem port.*

Designating an AppleTalk connection as the user port

Several AppleTalk connections may be available in the Network control panel on the router Macintosh. You can either use the *default* LocalTalk Built-In connection as the *user port* for nonrouting services available on the Macintosh when the router is running or designate another AppleTalk connection as the user port. The user port determines the zone in which the router Macintosh and any network services provided by that Macintosh reside.

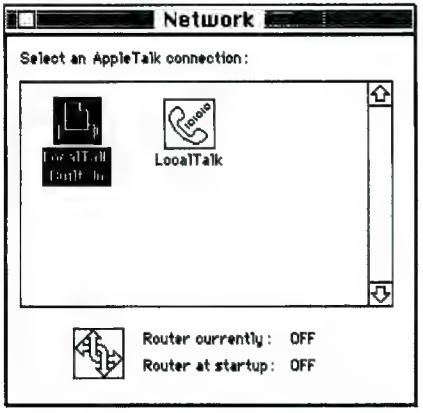
Once you have installed the router software and restarted the Macintosh, select an AppleTalk connection to designate it as the user port for the router Macintosh. To select a user port, follow these steps:

1 **Choose Control Panels from the Apple menu.**

The Network icon is in the Control Panels window that appears.

2 **Double-click the Network icon to open the Network control panel.**

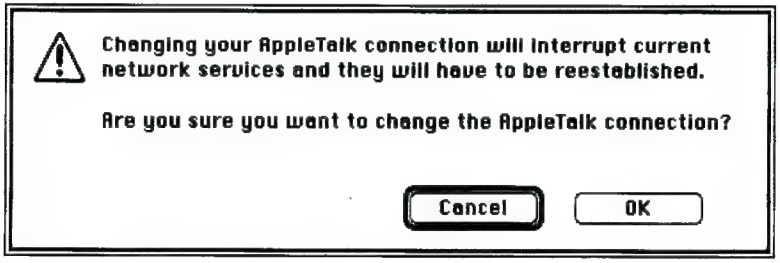
The Network control panel appears.



The Network control panel displays whatever AppleTalk connections are available on the router Macintosh. The ports available on the router Macintosh determine the AppleTalk connections installed by the Installer. Each icon in the Network control panel corresponds to a network that is connected to a port on the router. The LocalTalk Built-In connection for the printer port is the default AppleTalk connection. Other AppleTalk connections that may appear in the Network control panel include an EtherTalk connection for an Ethernet port, a TokenTalk connection for a Token Ring port, and a LocalTalk connection for the modem port. The AppleTalk connection currently in use appears highlighted.

3 **In the Network control panel, select an AppleTalk connection to designate the corresponding port as the user port.**

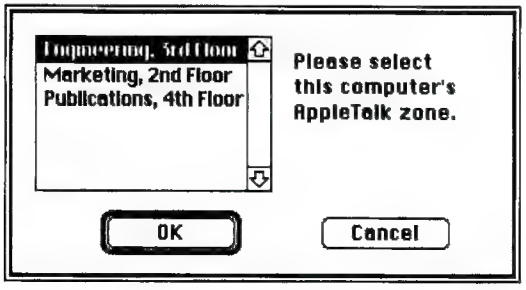
If you selected a different AppleTalk connection as the user port, the following alert box appears:


Changing your AppleTalk connection will interrupt current network services and they will have to be reestablished.
Are you sure you want to change the AppleTalk connection?
Cancel
OK

4 Click OK.

If you selected a LocalTalk connection as the user port for the router Macintosh, skip step 5.

If you selected an AppleTalk connection other than LocalTalk as the user port, one or more other routers are connected to that network, and you have not previously selected a zone for the router Macintosh, the following dialog box appears:



△ **Important** If this Apple Internet Router is the *only* router on the network, you must first start the router, then select a zone for the router. Follow the instructions in Chapter 3, "Setting Up the Apple Internet Router," then follow the instructions in the section "Changing the Router's Zone" in Chapter 8 to select a zone for the router Macintosh. △

5 **Select an AppleTalk zone from the list of available zones, then click OK.**

Whenever you select an AppleTalk connection other than LocalTalk as the user port *and* the connected network has more than one zone, you can select a zone in which the router Macintosh is to reside. The router Macintosh and any network services provided on that Macintosh appear in this zone in the Chooser.

The zone currently selected is highlighted. The router Macintosh remains in this zone until you select a different AppleTalk connection or select a different zone. For information about selecting a different zone for the router, see the section "Changing the Router's Zone" in Chapter 8.

If you don't select a zone for the router Macintosh, the zone specified as the default zone on a seed router on the network is selected automatically. For information about seed routers, see the section "Configuring the Router as a Seed Router or a Nonseed Router" in Chapter 4.

6 **Close the Network control panel.**

◆ **Note** If the Chooser is open when you change an AppleTalk connection, the network services shown in the Chooser are *not* updated. To display the services that are currently available, close the Chooser, then reopen it. ◆

3 Setting Up the Apple Internet Router

Once you have installed the router software included in the Basic Connectivity Package, and selected a user port and a zone for the router, you can begin setting up the router. Before starting the router, you must create a setup document and designate it as the startup document. This chapter explains how to use Router Manager to create a setup document, configure the router's startup options, specify an administrator's password, and start the router.

Creating a setup document

Router Manager allows you to create and open multiple setup documents. A *setup document* identifies the router and the networks connected to the router's ports.

A *router port* consists of a physical port and an access method. A router Macintosh has at least two *physical ports:* the printer port and the modem port. A router may also have other physical ports, such as an Ethernet port or a Token Ring port.

Each physical port has one or more *access methods.* Both the printer port and the modem port support two access methods: LocalTalk and DialUp. The *DialUp* access method provides half-routing through an asynchronous modem. Other types of ports support other access methods. For example, an Ethernet port supports EtherTalk Phase 2 and, if you have installed the AppleTalk/IP Wide Area Extension, the IP Tunnel access method. A Token Ring port supports the TokenTalk and IP Tunnel access methods.

A setup document lists all of the physical ports available on the router and the access methods available for each physical port. In the setup window, you can select one or more ports and access methods for configuration. As shown in Figure 3-1, a setup document lists the following information for each port configured on the router Macintosh:

- a port description
- the port's current status—active or inactive
- the port's current settings

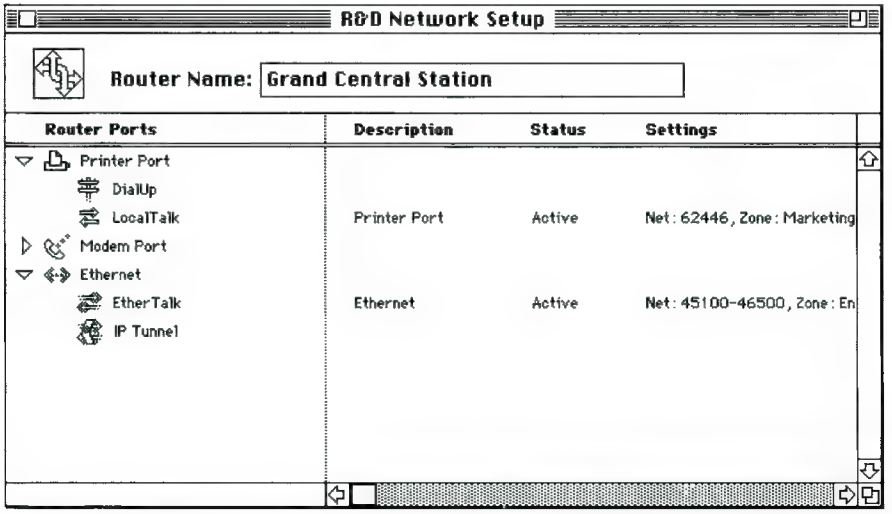


Figure 3-1 A setup document with configured ports

To create a setup document, follow these steps:

1 **If Router Manager is not already open, double-click the Router Manager icon to open Router Manager.**

When Router Manager opens for the first time or if you have not yet selected a setup document for the router to use at startup, an untitled setup document appears on the desktop. The setup document that the router uses at startup is referred to as the *startup document,* and contains the port description, status, and settings for each port that has been configured. Once you have selected a startup document, it opens whenever you open Router Manager. For information about selecting a startup document, see the section "Selecting a Startup Document" later in this chapter.

If a setup document appears, skip step 2.

2 **If necessary, choose New from the File menu to create a new setup document.**

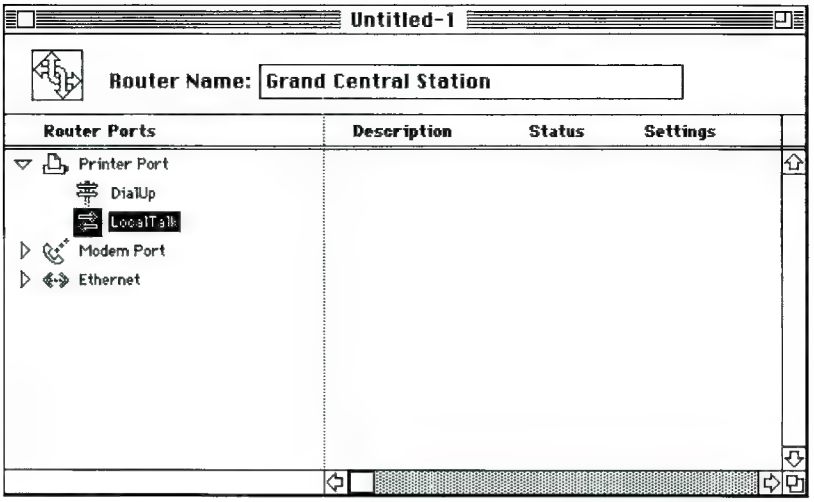
An untitled setup document appears on the desktop.

3 **In the setup window, type a name in the Router Name text box if you want to assign a different name to the router Macintosh.**

The name of the Macintosh on which the router is installed appears in the Router Name text box by default. A router name must be 32 or fewer characters in length. A router name that consists only of the equal sign (=) character is not allowed.

4 **Double-click a physical port, or click the right-pointing triangle to the left of that port, to display the access methods that are available for that port.**

If the access methods for a port are currently displayed, click the downward-pointing triangle to the left of that port and the access methods will no longer be listed. The following figure shows a setup document with the access methods for a physical port displayed.

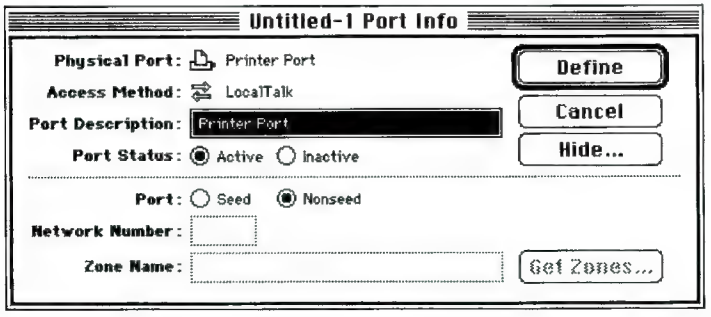


△ **Important** When creating a setup document, you *must* configure the port designated as the user port. △

5 Double-click an access method for the port that you want to configure.

Alternatively, you can click an access method to select it, then choose Define Port Info from the Edit menu.

A Port Info dialog box appears in which you can configure the port. If you selected a LocalTalk access method, the Port Info dialog box shown in the following figure appears.



The Port Info dialog box displays the name of the setup document, and the physical port and access method being configured.

6 In the Port Info dialog box, type a port description in the Port Description text box.

The name of the physical port appears in the Port Description text box by default. You can specify an optional port description to help you to identify the network connected to the port. A port description can be up to 31 characters in length and can contain any characters, including the space character.

7 Configure the port.

The procedure for configuring a port varies, depending on the type of port and the access method being configured. The Apple Internet Router supports three types of router ports:

- AppleTalk ports—through which a LocalTalk, EtherTalk, or TokenTalk access method provides connectivity between local internets of the same type or different types
- half-routing ports—through which the DialUp or another access method provides point-to-point connectivity
- tunneling ports—through which an access method for a foreign network system provides multipoint connectivity

The following road map directs you to the appropriate guides, chapters, and sections for detailed information about configuring a specific access method for a port. You need to read only those chapters and sections that pertain to the port and access method that you want to configure. Once you have configured all of the ports on the router Macintosh, you must finish creating your setup document.

	To configure . . .	**Do this . . .**
	A LocalTalk port	Follow the steps in the sections "Configuring a LocalTalk Port" and "Hiding Devices on an Internet" in Chapter 4 of this guide.
	An EtherTalk port	Follow the steps in the sections "Configuring an EtherTalk or TokenTalk Port" and "Hiding Devices on an Internet" in Chapter 4 of this guide.
	or	
	A TokenTalk port	

(continued)➡

	To configure . . .	Do this . . .
	A half-routing port	Follow the steps in Chapter 5 of this guide, "Half-Routing," and in Chapter 7 of this guide, "Configuring the Wide Area Routing Options."
	An IP Tunnel port	Follow the instructions in *Using the AppleTalk/IP Wide Area Extension,* and in Chapter 7 of this guide, "Configuring the Wide Area Routing Options."
	An X.25 port	Follow the instructions in *Using the X.25 Wide Area Extension,* and in Chapter 7 of this guide, "Configuring the Wide Area Routing Options."

8 **In the Port Info dialog box, click the Active button to activate the port, if it is not already active.**

When you first configure a port, its status is active by default. When the router is running, it routes data packets through all active ports. You can change the status of the port being configured from active to inactive by clicking the Inactive button.

9 **When you have finished specifying your port configuration, click Define to close the Port Info dialog box.**

10 **Repeat steps 4 through 9 for each port that you want to configure.**

11 **Name and save your setup document.**

If Router Manager encounters an error in the setup information, it will cancel the save.

Configuring the router for startup

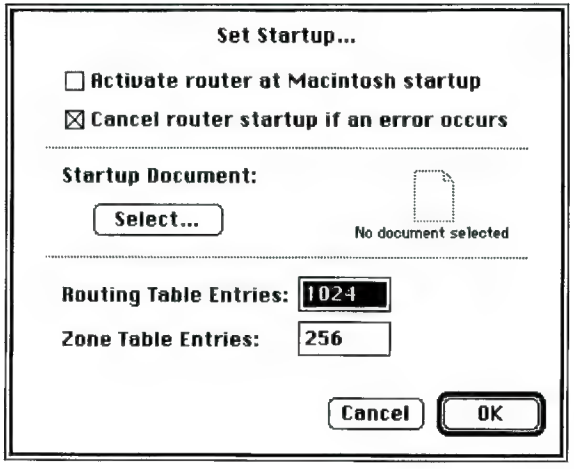
The following sections describe the various startup options that you can configure for the router.

Selecting a startup document

Before you can start the router, you must select a setup document for the router to use at startup. This setup document is referred to as the *startup document.* To select a startup document, follow these steps:

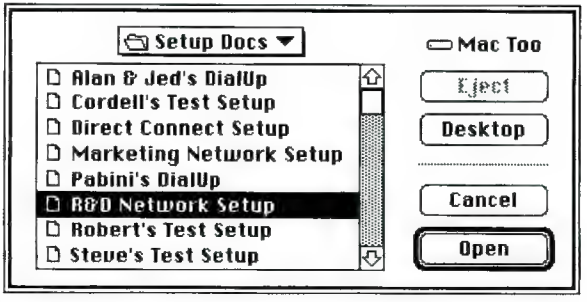
1 Choose Set Startup from the Control menu.

The Set Startup dialog box appears.



2 Click Select.

The following dialog box appears:



3 Select the setup document that you want to designate as the startup document in the list box, then click Open.

The name of the startup document that you selected appears beneath the document icon in the Set Startup dialog box. Router Manager will use this startup document when you start the router.

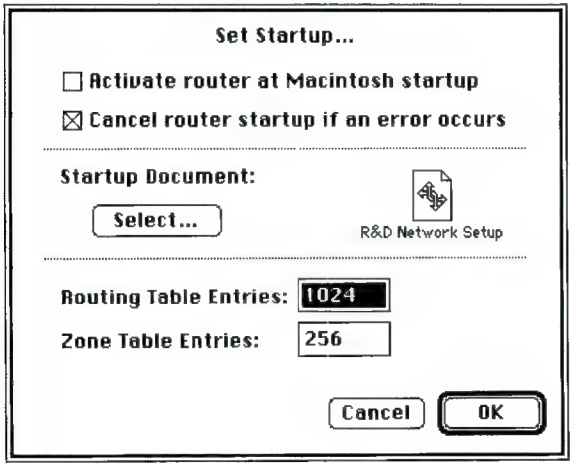
4 Click OK to close the Set Startup dialog box.

Starting the router at system startup

To activate the router automatically when you start up the Macintosh, follow these steps:

1 Choose Set Startup from the Control menu.

The Set Startup dialog box appears.



2 To activate the router when you start up the router Macintosh, click the "Activate router at Macintosh startup" checkbox to select it, if it's not already selected.

3 Click OK.

◆ **Note** If "Activate router at Macintosh startup" is selected when you start up the router Macintosh, you can prevent the router from starting by holding down the ⌘ key until a message informs you that router startup has been canceled. ◆

Canceling router startup if an error occurs

If the router encounters an error at startup—such as a network-numbering conflict in a port configuration—it can either continue startup, activating *only* ports on which no errors occur, or cancel startup.

By default, the router cancels startup if it encounters an error. If the "Cancel router startup if an error occurs" checkbox is not selected, the router starts up and records the status of its ports in the Router Log, indicating any errors that occur at startup. Any port on which an error occurred remains inactive until you correct the error, then activate the port in its Port Info dialog box.

To cancel router startup if an error occurs, follow these steps:

1 **Choose Set Startup from the Control menu.**

The Set Startup dialog box appears.

2 **Select "Cancel router startup if an error occurs," if it's not already selected.**

3 **Click OK.**

Specifying the routing table's maximum size

The router maintains a routing table that contains the routing information for each destination network on an internet. For detailed information about the routing table, see the section "The Routing Table" in Chapter 9. If you need more memory for other programs running concurrently with the router, you can reduce the size of the routing table—that is, the maximum number of entries that the routing table can contain. Or, to support a greater number of networks on the internet, you can increase the size of the routing table.

To specify the maximum number of entries that the routing table can contain, follow these steps:

1 **Choose Set Startup from the Control menu.**

The Set Startup dialog box appears. By default, the maximum number of entries that the routing table can contain is 1024.

2 **Type a number in the Routing Table Entries text box.**

The amount of memory installed in the router Macintosh determines the maximum number of entries that the routing table can contain.

3 **Click OK.**

The new maximum number of routing table entries takes effect when you next restart the router Macintosh.

Specifying the zone table's maximum size

The router maintains a zone table that contains the zone information for each destination network on an internet. If you need more memory for other programs running concurrently with the router, you can reduce the size of the zone table—that is, the maximum number of entries that the zone table can contain. Or, to support a greater number of zones on the internet, you can increase the size of the zone table.

To specify the maximum number of entries that the zone table can contain, follow these steps:

1 **Choose Set Startup from the Control menu.**

The Set Startup dialog box appears. By default, the maximum number of entries that the zone table can contain is 256.

2 **Type a number in the Zone Table Entries text box.**

The amount of memory installed in the router Macintosh determines the maximum number of entries that the zone table can contain.

3 **Click OK.**

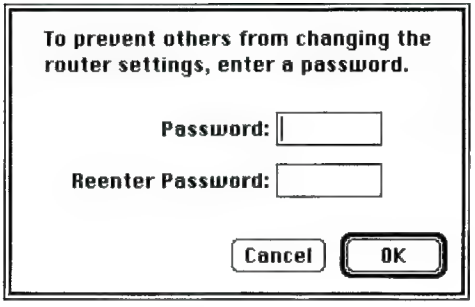
The new maximum number of zone table entries takes effect when you next restart the router Macintosh.

Specifying an administrator's password

To prevent others from opening Router Manager and changing your setup documents or the router's status, you can specify an *administrator's password.*

1 **Choose Set Password from the Control menu.**

The following dialog box appears:



2 **Type your password in the Password text box.**

A password can have a maximum of eight characters. You can use uppercase and lowercase letters to distinguish passwords. The characters that you type appear as bullets to prevent others from learning your password.

3 **Press Tab to move to the Reenter Password text box, then type your new password again, exactly as you did the first time.**

You must type your password *exactly* as you did before, including your use of uppercase and lowercase letters. Typing your password again confirms that you have entered it correctly.

4 **Click OK to turn on password protection.**

Once you have set an administrator's password, you must thereafter enter your password to open Router Manager to edit a setup document or change the router's status.

◆ **Note** To prevent others from making unauthorized changes in Router Manager, always quit Router Manager when you are not using it.

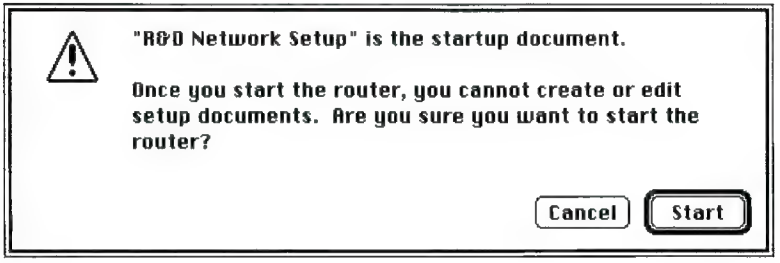
Always keep a written record of your password. If you forget your password, you must remove the router software from the startup disk and reinstall the router software. ◆

Starting the router

Once you have installed the router, created and saved a setup document, and selected a startup document, you can start the router at any time without restarting the router Macintosh. To start the router, follow these steps:

1 Choose Start Router from the Control menu.

The following alert box appears:

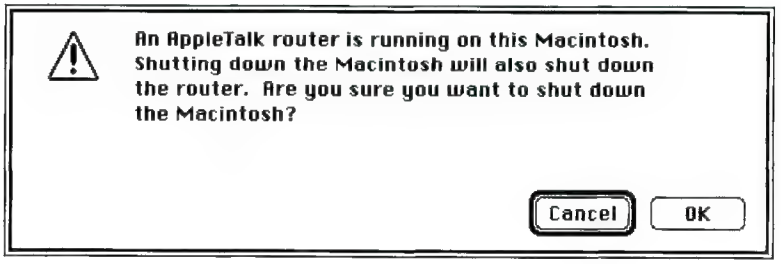

"R&D Network Setup" is the startup document.
Once you start the router, you cannot create or edit setup documents. Are you sure you want to start the router?
Cancel
Start

2 Click Start to confirm that you want to start the router.

Once the router starts, the Start Router command changes to Stop Router. The router status indicator in the Network control panel indicates that the router is currently on.

When the router is running:

- Opening or quitting Router Manager does not affect router operation. The router runs in the background, independent of the Router Manager application program.
- If you open Router Manager, it displays any windows that were open when Router Manager was last open.
- You cannot edit setup documents.
- You can activate and deactivate ports on the router, as described in the section "Activating and Deactivating Ports" in Chapter 8.
- You should not deactivate AppleTalk in the Chooser.
- If you try shutting down the router Macintosh, the following alert box appears. To confirm that you want to shut down the router Macintosh, click OK.


An AppleTalk router is running on this Macintosh. Shutting down the Macintosh will also shut down the router. Are you sure you want to shut down the Macintosh?
Cancel
OK

Quitting Router Manager

The Apple Internet Router runs in the background. You can quit Router Manager after starting the router.

Once you have finished creating setup documents and have configured the startup options for the router, quit Router Manager. To quit Router Manager, choose Quit from the File menu.

4 Configuring an AppleTalk Port

This chapter describes port configuration for three types of AppleTalk ports—LocalTalk, EtherTalk, and TokenTalk—including how to configure the router as a seed router or a nonseed router, and how to hide devices on an internet.

Configuring the router as a seed router or a nonseed router

A *seed router* sends an AppleTalk network's identifying information to all other routers connected directly to that network. You *must* configure at least one router on each AppleTalk network in an internet as a seed router. To configure the router as a seed router for a network, when configuring the port to which that network is connected, designate that port as a seed port and specify the network's identifying information. The sections "Configuring a LocalTalk Port" and "Configuring an EtherTalk or TokenTalk Port" later in this chapter describe how to configure seed and nonseed ports.

If more than one router is connected to an AppleTalk network, it is necessary to specify this identifying information on only one of the connected routers. However, you can configure more than one router on a network as a seed router.

△ **Important** If more than one router is a seed router for a network, you must specify exactly the same information for that network when configuring the seed port on each seed router connected to that network. △

A router that obtains the network number or network range and the zone name or zone list for an AppleTalk network from a seed router connected to that network is a *nonseed router.* Once you have configured one seed router for a network connected to a port, you can configure any additional routers on the network as either seed or nonseed routers.

A router can be both a seed router and a nonseed router for different networks. Because a router can function as a seed router for some networks and a nonseed router for others, the router's ports are designated as *seed ports* and *nonseed ports.* Figure 4-1 shows both seed routers and nonseed routers on an internet.

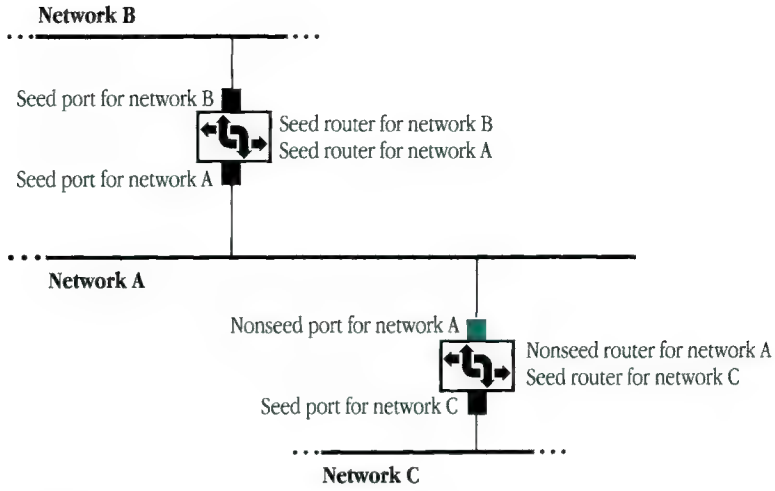

Network B
Seed port for network B
Seed router for network B
Seed router for network A
Seed port for network A
Network A
Nonseed port for network A
Nonseed router for network A
Seed router for network C
Seed port for network C
Network C

Figure 4-1 Seed and nonseed routers on an internet

Identifying networks on an internet

Networks connected by the router retain separate identities. Each AppleTalk network in an internet must have a unique network number or network range.

- A single *network number* identifies a LocalTalk network.
- A *network range* is a series of contiguous network numbers that identifies any other type of AppleTalk network, such as an EtherTalk or TokenTalk network. A network range can neither include a network number already assigned to another network nor overlap another network range.

Each network in an internet can include a maximum of 253 devices. You can assign up to 253 devices to each network number in a network range. Thus, a network range determines the maximum number of devices on a network. For example, a network having the network range 1–10 could include up to 2530 devices (10 × 253).

When configuring a seed port on the router, you must assign a unique network number or network range to the network connected to that port. Router Manager prevents you from assigning network numbers or ranges that conflict with those configured for other ports on the router. However, the router cannot detect conflicting network numbers or ranges on other parts of the internet. If you assign a number to a network and that number is different from the number assigned to that network on another seed router, the router will not be able to start. Maintaining an up-to-date map of the networks in your internet, which you can refer to when assigning network numbers or ranges, can help you to avoid assigning duplicate network numbers or overlapping network ranges.

For more detailed information about assigning network numbers and network ranges, see the sections "Configuring a LocalTalk Port" and "Configuring an EtherTalk or TokenTalk Port" later in this chapter, and "Choosing a Network-Numbering Scheme" and "Specifying Network Ranges" in Appendix A.

Defining AppleTalk zones for a network

When configuring a seed port on the router, you can define one or more AppleTalk zones for the network connected to that port by assigning a zone name or zone list to that network. You *must* define at least one zone for each AppleTalk network in an internet. A LocalTalk network can have *only* one zone. Thus, you can assign only one zone name to a LocalTalk network.

Other types of AppleTalk networks can have multiple zones. Thus, you can assign a zone list to any other type of AppleTalk network. A zone list includes all of the zone names assigned to a network and can consist of a maximum of 255 zone names. You can assign any device on a network to any zone in the zone list for that network. You must include at least one zone name in a zone list. For more detailed information about zone names and zone lists, see the sections "Configuring a LocalTalk Port" and "Configuring an EtherTalk or TokenTalk Port" later in this chapter, and "Dividing an Internet Into Zones" in Appendix A.

Configuring a LocalTalk port

To configure a LocalTalk access method for a printer port or modem port, follow these steps:

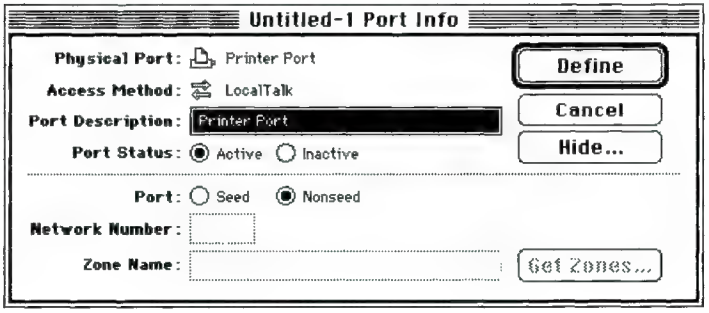
1 Open a setup document.

2 In the setup window, double-click the physical port that you want to configure to display the access methods that are available for that port.

A LocalTalk access method is always available for the modem port and for the printer port.

3 Double-click the LocalTalk access method.

The LocalTalk Port Info dialog box appears.



4 In the LocalTalk Port Info dialog box, type a port description in the Port Description text box.

The name of the physical port appears in the Port Description text box by default. You can specify an optional port description to help you to identify the network connected to the port. A port description can be up to 31 characters in length and can contain any characters, including the space character.

5 Designate the port as a seed port or a nonseed port. To designate the port as a seed port, select the Seed button. To designate the port as a nonseed port, select the Nonseed button.

To configure the LocalTalk port as a seed port, you must assign a network number and a zone name to the network connected to that port.

A port is designated as a nonseed port by default. You can configure a port as a nonseed port *only* if you have already configured a seed router for the network connected to that port. If you configure the LocalTalk port as a nonseed port, the router will obtain the network number and zone name for the network connected to that port from a seed router on the network.

If you are configuring the LocalTalk port as a nonseed port, skip steps 6 and 7.

6 **If you designated the LocalTalk port as a seed port, type a number in the Network Number text box to assign a number to the network connected to that port.**

You can specify a network number as either a decimal number between 1 and 65,279, or a hexadecimal number between $1 and $FEFF. In Router Manager, a *$* character must precede hexadecimal numbers.

△ **Important** A network number must be unique in an internet. Do *not* assign the same network number to more than one network. △

7 **Type the zone name for the network connected to that port in the Zone Name text box.**

A zone name can be up to 32 characters in length and can contain any characters, including the space character. You cannot use uppercase and lowercase letters to distinguish zone names. Thus, you can type a zone name using either uppercase or lowercase letters.

◆ **Note** You cannot use a single asterisk (*) character as a zone name. AppleTalk protocols use the asterisk as a wildcard character, signifying "this zone"—that is, the zone in which the sending device resides. ◆

Alternatively, you can select the network's zone name from a list of connected zones, as described in the next section, "Selecting a Zone Name From a List of Connected Zones."

8 **To activate the LocalTalk port, select the Active button. To deactivate the LocalTalk port, select the Inactive button.**

When you first configure a port, its status is active by default. When the router is running, it routes data packets through all active ports. You can change the status of the LocalTalk port from active to inactive at any time.

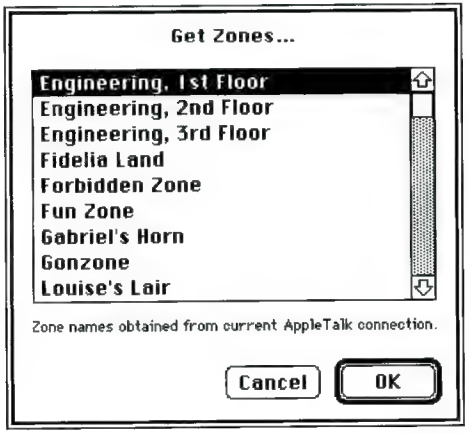
9 When you have finished specifying the LocalTalk port information, click Define to close the LocalTalk Port Info dialog box.

Selecting a zone name from a list of connected zones

When configuring a LocalTalk port as a seed port, instead of typing a zone name for the network connected to that port, you can select a zone name from a list of zones. To select a zone name from a list of zones, follow these steps:

1 In the LocalTalk Port Info dialog box, click Get Zones.

The Get Zones dialog box appears. It lists all of the zones on the internet connected to the current AppleTalk connection for the router Macintosh.



2 In the Get Zones dialog box, select a zone name in the list of connected zones.

When configuring a LocalTalk port, you can select only one zone.

3 Click OK.

The name of the zone selected appears in the Zone Name text box in the LocalTalk Port Info dialog box.

Configuring an EtherTalk or TokenTalk port

To configure an EtherTalk access method for an Ethernet port or a TokenTalk access method for a Token Ring port, follow these steps:

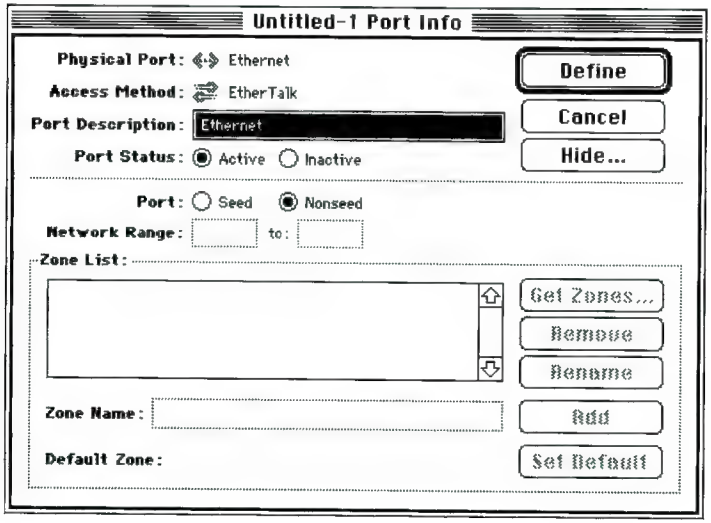
1 Open a setup document.

2 In the setup window, double-click the Ethernet or Token Ring port that you want to configure to display the access methods that are available for that port.

An EtherTalk access method is available whenever an Ethernet port is present on the router Macintosh. A TokenTalk access method is available whenever a Token Ring port is present.

3 Double-click the EtherTalk or TokenTalk access method.

The EtherTalk or TokenTalk Port Info dialog box appears. The following figure shows an EtherTalk Port Info dialog box.



4 **In the EtherTalk or TokenTalk Port Info dialog box, type a port description in the Port Description text box.**

The name of the physical port appears in the Port Description text box by default. You can specify an optional port description to help you to identify the network connected to the port. A port description can be up to 31 characters in length and can contain any characters, including the space character.

5 **Designate the port as a seed port or a nonseed port. To designate the port as a seed port, select the Seed button. To designate the port as a nonseed port, select the Nonseed button.**

To configure the EtherTalk or TokenTalk port as a seed port, you must assign a network range and a zone list to the network connected to that port.

A port is designated as a nonseed port by default. You can configure a port as a nonseed port *only* if a seed router has already been configured for the network connected to that port. If you configure the EtherTalk or TokenTalk port as a nonseed port, the router will obtain the network range and zone list for the network connected to that port from a seed router on the network.

If you are configuring the EtherTalk or TokenTalk port as a nonseed port, skip steps 6 and 7.

6 **If you designated the EtherTalk or TokenTalk port as a seed port, type the lowest network number in the network range for the network connected to that port in the Network Range text box and the highest network number in the network range in the "to" text box.**

△ **Important** A network range must be unique in an internet. It can neither include a network number already assigned to another network nor overlap another network range. △

A network range must consist of a series of contiguous network numbers. You can specify a network range as two decimal numbers between 1 and 65,279, or two hexadecimal numbers between $1 and $FEFF. In Router Manager, a *$* character must precede hexadecimal numbers. If you don't expect a network to grow beyond 253 devices, you can assign a single network number to a range—for example, you can specify a network range from 14 to 14.

7 **Type a zone name in the Zone Name text box, then click Add to add the zone name to the zone list for the network connected to that port.**

You *must* add at least one zone name to the zone list. A zone name can be up to 32 characters in length and can contain any characters, including the space character. You cannot use uppercase and lowercase letters to distinguish zone names. Thus, you can type a zone name using either uppercase or lowercase letters.

◆ **Note** You cannot use a single asterisk (*) character as a zone name. AppleTalk protocols use the asterisk as a wildcard character, signifying "this zone"—that is, the zone in which the sending device resides. ◆

You can add zone names to the zone list in any order. Repeat this step until you have added all of the network's zone names to the zone list. A zone list can consist of a maximum of 255 zone names.

Alternatively, you can select zone names to be included in the zone list from a list of connected zones, as described in the next section, "Including Names of Connected Zones in the Zone List."

You can rename a zone in the zone list or remove a zone name from the zone list, as described in the sections "Renaming a Zone in the Zone List" and "Removing a Zone Name from the Zone List" later in this chapter. You can also set a default zone for the network connected to the port, as described in the section "Setting the Default Zone for the Network" later in this chapter.

8 **To activate the EtherTalk or TokenTalk port, select the Active button. To deactivate the EtherTalk or TokenTalk port, select the Inactive button.**

When you first configure a port, its status is active by default. When the router is running, it routes data packets through all active ports. You can change the status of the port from active to inactive at any time.

9 **When you have finished specifying the EtherTalk or TokenTalk port information, click Define to close the Port Info dialog box.**

Adding names from a list of connected zones to the zone list

When configuring an EtherTalk or TokenTalk port as a seed port, instead of typing each zone name, you can select one or more zone names from a list of zones on the internet connected to the router's current AppleTalk connection, and add them to the zone list for the network connected to that port. Follow these steps to add the zone names to the zone list:

1 **In the EtherTalk or TokenTalk Port Info dialog box, click Get Zones.**

The Get Zones dialog box appears. It lists all of the zones on the internet connected to the current AppleTalk connection for the router Macintosh.

2 **In the Get Zones dialog box, select one or more zone names in the list of connected zones.**

Shift-click to select multiple zone names.

3 **Click OK.**

The zone names selected appear in the zone list in the EtherTalk or TokenTalk Port Info dialog box.

Renaming a zone in the zone list

When configuring an EtherTalk or TokenTalk port as a seed port, follow these steps to rename a zone in the zone list:

1 **In the EtherTalk or TokenTalk Port Info dialog box, select the name of a zone in the zone list.**

The name appears in the Zone Name text box.

2 **Type the new name for the zone in the Zone Name text box.**

3 **Click Rename.**

The new name replaces the old name in the zone list.

Removing a zone name from the zone list

When configuring an EtherTalk or TokenTalk port as a seed port, follow these steps to remove a zone name from the zone list:

1 **In the EtherTalk or TokenTalk Port Info dialog box, select the name of a zone in the zone list.**

The name appears in the Zone Name text box.

2 **Click Remove.**

The zone name no longer appears in the zone list.

◆ **Note** If you remove the default zone from the zone list, the first name in the zone list becomes the default zone. ◆

Setting the default zone

When configuring an EtherTalk or TokenTalk port as a seed port, you can designate a default zone for the network connected to that port. The first zone that you add to the zone list for the network connected to the port automatically becomes the default zone for that network. The router automatically assigns each device in that network to the default zone. A device assigned to the default zone resides in that zone until another zone is selected for the device.

To change the default zone for the connected network, follow these steps:

1 **In the EtherTalk or TokenTalk Port Info dialog box, select a zone name in the zone list.**

2 **Click Set Default.**

The zone selected becomes the default zone.

Hiding devices on an internet

Large internets—for example, local area networks (LANs) that span more than one department or wide area networks (WANs) that span more than one organization—may require device-level security. You can achieve device-level security by configuring *device hiding* on AppleTalk ports.

When configuring an AppleTalk port on the router, you can specify that certain devices on the network or internet connected to that port be hidden from only *one* other port or *all* other ports on the router. Thus, you can prevent devices on a specific part of the internet or on all other parts of the internet from accessing the devices for which you specify device hiding.

You can hide any device on the part of the internet that is connected to an AppleTalk port. A device need not be on the network that is connected directly to that port. As Figure 4-2 shows, a hidden device does not appear in the Chooser on computers that are on the part of the internet from which the device is hidden. However, a hidden device still has access to devices on the part of the internet from which it is hidden—that is, those devices appear in the Chooser on the hidden device.

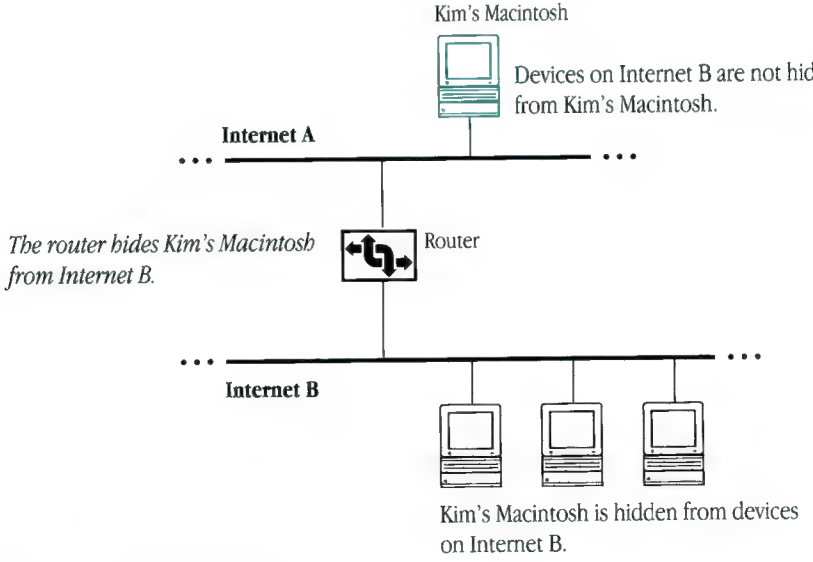

Kim's Macintosh
Devices on Internet B are not hidden from Kim's Macintosh.
Internet A
The router hides Kim's Macintosh from Internet B.
Router
Internet B
Kim's Macintosh is hidden from devices on Internet B.

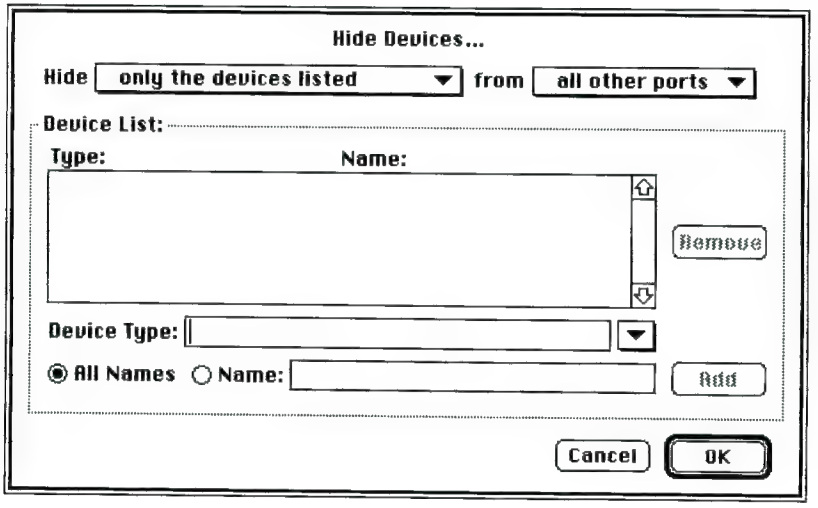
Figure 4-2 Device hiding

△ **Important** If you want to hide a device and more than one path connects the device and the part of the internet from which you want to hide the device, you must hide the device on a router on each path that connects the device and the internet from which you want to hide the device. △

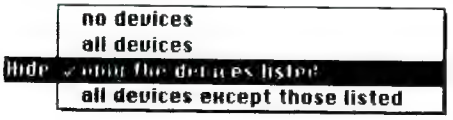
To hide devices connected to an AppleTalk port, follow these steps:

1 In the Port Info dialog box for an AppleTalk port, click Hide.

The Hide Devices dialog box appears.



2 In the Hide Devices dialog box, select an option in the Hide pop-up menu to specify whether devices are to be hidden and how to list the devices.



In the Hide pop-up menu, "only the devices listed" is selected by default. If you select "all devices except those listed," the devices that you add to the device list will appear in the Chooser.

If you selected "no devices," skip steps 3 and 4.

3 **Select an option in the "from" pop-up menu to specify whether the devices are to be hidden from all other ports or from a specific port.**

To hide devices from all ports, select "all other ports" in the "from" pop-up menu. All configured ports on the router appear in the "from" pop-up menu. To hide devices from a specific port, select that port in the "from" pop-up menu.

If you selected "all devices" in step 2, skip steps 4 through 7.

4 **Select an option in the Device Type pop-up menu to specify the type of device to be hidden, or type a specific device type in the Device Type text box.**

The Device Type pop-up menu contains the device types found on the network connected to the current AppleTalk connection for the router Macintosh. Some standard device types always appear in the Device Type pop-up menu. The use of uppercase and lowercase letters does not distinguish device types. Thus, you can type a device type in the Device Type text box using either uppercase or lowercase letters.

5 Select the Name button and type a device name in the Name text box to hide a specific device of a specific type, or select the All Names button to hide all devices of that type.

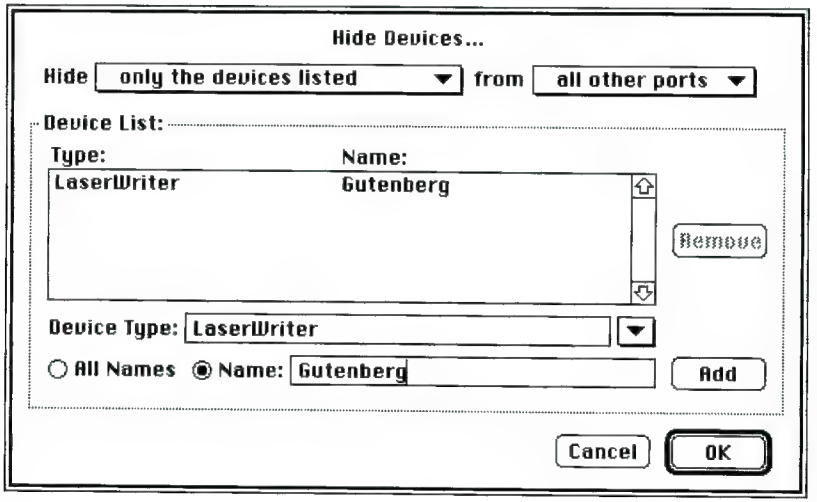
You *cannot* use uppercase and lowercase letters to distinguish device names. Thus, you can type a device name in the Name text box using either uppercase or lowercase letters.

6 Click Add.

Depending on the selection that you made in the previous step, one of the following appears in the device list:

- a device type and the name of a specific device
- a device type and "<All >"

As the example in the following figure shows, you could specify that a device of the type *LaserWriter* with the name *Gutenberg* be hidden from all other ports on the router.



7 To hide additional devices of specific types, repeat steps 4 through 6 for each device type.

8 Click OK.

5 Half-Routing

A *half-router* is a router that connects two remote AppleTalk networks or internets. You can achieve wide area connectivity through *half-routing,* in which two half-routers connect two remote AppleTalk networks or internets over a point-to-point link. A *point-to-point link* is a communications path that may consist of two modems communicating over a standard telephone line or a leased line. This chapter explains how to set up a half-routing port to originate a connection, answer to establish a connection, or call back to establish a connection.

For information about configuring an X.25 port to establish point-to-point links between remote AppleTalk networks or internets, see *Using the AppleTalk/X.25 Wide Area Extension.*

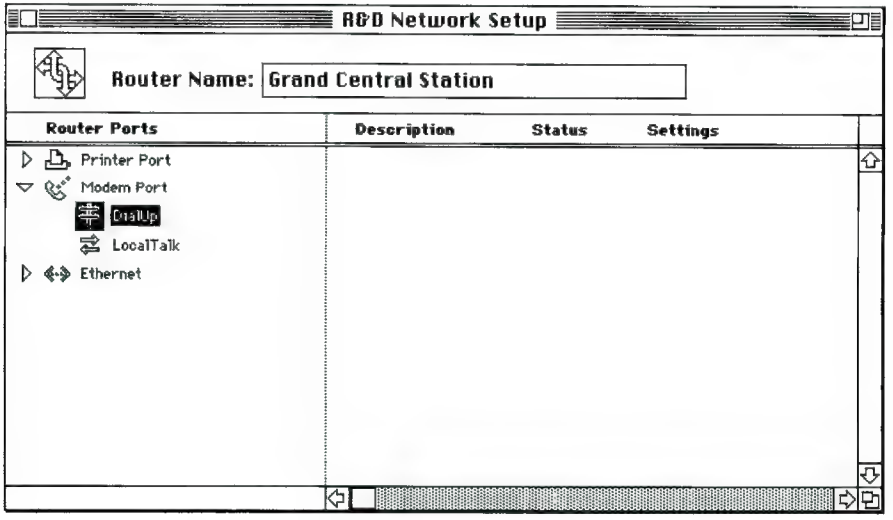
Configuring a half-routing port

To configure a half-routing port, follow these steps:

1 Open a setup document.

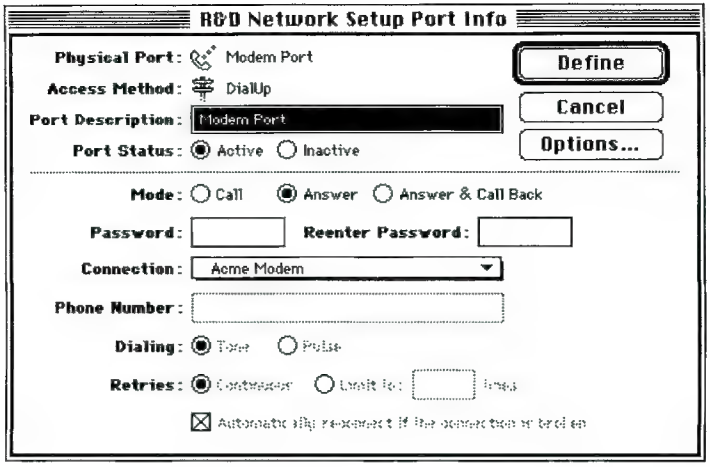
2 In the setup window, double-click the physical port that you want to configure to display the access methods that are available for that port.

A DialUp access method is available for the printer port and the modem port. The following figure shows a setup window with DialUp selected.



3 Double-click a DialUp access method to open a DialUp Port Info dialog box.

A DialUp Port Info dialog box appears.



4 **In the DialUp Port Info dialog box, type a port description in the Port Description text box.**

The name of the physical port appears in the Port Description text box by default. You can specify an optional port description to help you to identify the network connected to the port. A port description can be a maximum of 31 characters in length and can contain any characters, including the space character.

Depending on the method that you want to use to establish a connection, follow the instructions in one of the subsequent sections to complete the half-routing port configuration:

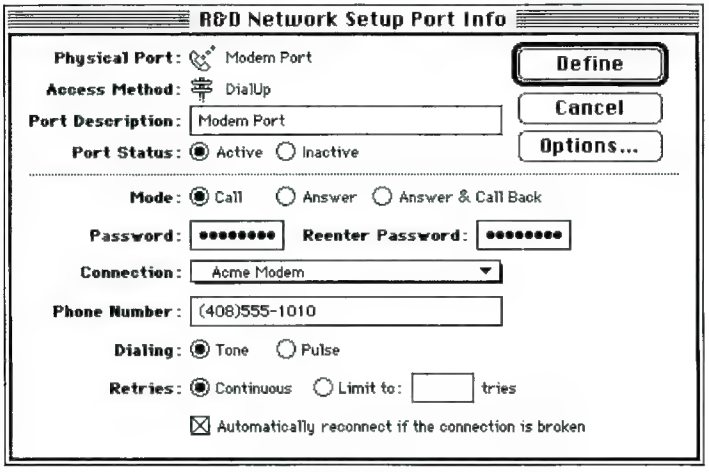
- See the section "Originating a Connection" to learn how to originate a connection.
- See the section "Answering to Establish a Connection" to learn how to answer to establish a connection.
- See the section "Calling Back to Establish a Connection" to learn how to call back to establish a connection.

Originating a connection

Using a modem, you can call another exterior router to establish a connection. To configure the half-routing port to originate a connection, follow these steps:

1 **In the DialUp Port Info dialog box, click the Call button to select that mode.**

The options shown in the following figure appear in the DialUp Port Info dialog box. The figure shows a half-routing port configured to originate a connection.



2 **Type your password in the Password text box.**

You can provide greater security on your WAN by using an optional password on half-routing links. The half-router originating the connection sends the password across the link to another half-router. That half-router verifies the password before establishing a connection with the half-router originating the connection.

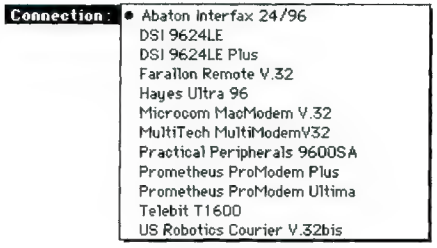
A password can have a maximum of eight characters. You can use uppercase and lowercase letters to distinguish passwords.

When you type your password in the Password text box, the characters that you type appear as bullets to prevent others from learning your password.

3 Press Tab, then type your password again in the Reenter Password text box, exactly as you did the first time, to verify that you entered the password correctly.

You must type your password *exactly* as you did before, including your use of uppercase and lowercase letters. Typing your password again confirms that you have entered it correctly.

4 Select a modem connected to the router Macintosh in the Connection pop-up menu.



The Apple Internet Router supports half-routing links using various asynchronous modems that transmit data at rates of 9600 bits per second (bps) or greater. You can connect a modem to either the modem port or the printer port.

5 Type the phone number that you are calling in the Phone Number text box.

6 Click the Tone button to select tone dialing. Or, to select pulse dialing, click the Pulse button.

7 To select continuous retries, click the Continuous button. Or, to limit the number of retries, click the "Limit to" button, then type the number of tries in the text box.

If you select continuous retries, the router will redial until it makes a connection.

8 To allow automatic reconnection if the modem loses a connection, click the "Automatically reconnect if the connection is broken" checkbox to select it.

9 **To activate the DialUp port, select the Active button. To deactivate the DialUp port, select the Inactive button.**

When you first configure a port, its status is active by default. When the router is running, it routes data packets through all active ports. You can change the status of the DialUp port from active to inactive at any time.

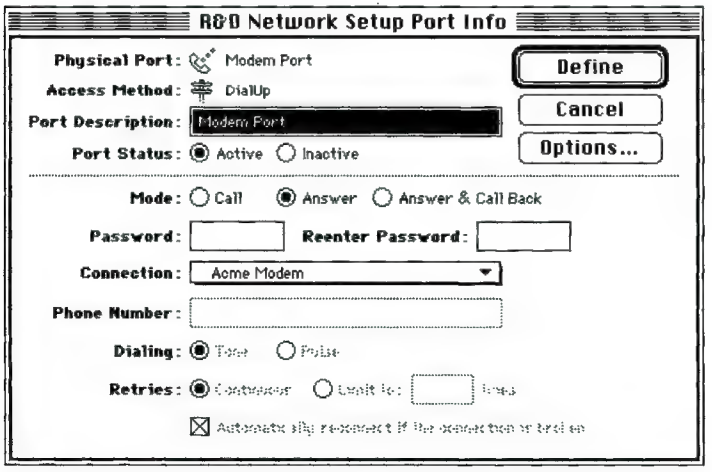
10 **When you have finished specifying the DialUp port information, click Define to close the DialUp Port Info dialog box.**

Answering to establish a connection

To configure the half-routing port to answer a call from another router to establish a connection, follow these steps:

1 **In the DialUp Port Info dialog box, click the Answer button to select that mode.**

The options shown in the following figure appear in the DialUp Port Info dialog box. The figure shows a half-routing port configured to answer to establish a connection.



2 **Type the caller's password in the Password text box.**

You can use an optional password on a half-routing link. The calling half-router sends the password across a link to the answering half-router, which verifies the password before establishing a connection with the calling half-router.

A caller's password can have a maximum of eight characters. You can use uppercase and lowercase letters to distinguish passwords. You must type a caller's password *exactly* as it was specified, including the use of uppercase and lowercase letters.

When you type the caller's password in the Password text box, the characters that you type appear as bullets to prevent others from learning your password.

3 **Press Tab, then type the caller's password again in the Reenter Password text box, exactly as you did the first time, to verify that you have entered the password correctly.**

You must type the caller's password *exactly* as you did before, including the use of uppercase and lowercase letters. Typing the password again confirms that you have entered it correctly.

4 **Select a modem connected to the router Macintosh in the Connection pop-up menu.**

The Apple Internet Router supports half-routing links using various asynchronous modems that transmit data at rates of 9600 bits per second (bps) or greater. You can connect a modem to either the modem port or the printer port.

5 **To activate the DialUp port, select the Active button. To deactivate the DialUp port, select the Inactive button.**

When you first configure a port, its status is active by default. When the router is running, it routes data packets through all active ports. You can change the status of the DialUp port from active to inactive at any time.

6 **When you have finished specifying the DialUp port information, click Define to close the DialUp Port Info dialog box.**

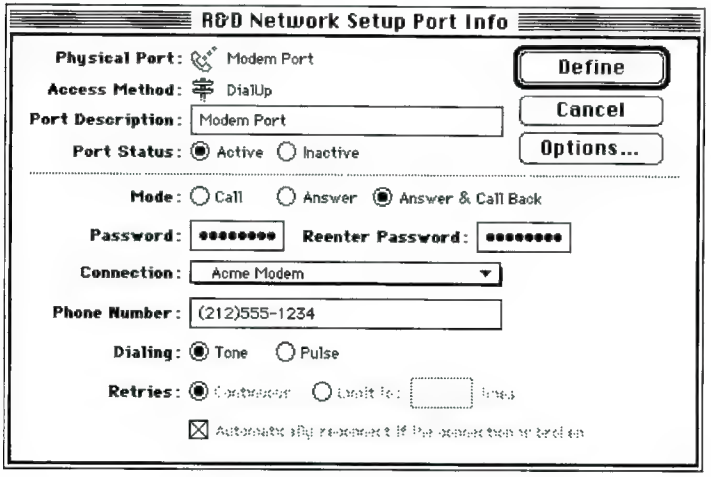
Calling back to establish a connection

To provide greater security on your WAN, the router can call back a router that is calling to establish a connection. If you specify the answer-and-call-back mode, when the router answers a call from another router, it verifies the caller's password, if any, then hangs up and calls back the calling router to establish the connection.

To call back a router to establish a connection, follow these steps:

1 **In the DialUp Port Info dialog box, click the Answer & Call Back button to select that mode.**

The options shown in the following figure appear in the DialUp Port Info dialog box. The figure shows a half-routing port configured to answer and call back to establish a connection.



2 **Type your password in the Password text box.**

You can use an optional password on a half-routing link. The calling half-router sends the password across a link to the answering half-router, which verifies the password before establishing a connection with the calling half-router.

A caller's password can have a maximum of eight characters. You can use uppercase and lowercase letters to distinguish passwords. You must type a caller's password *exactly* as it was specified, including the use of uppercase and lowercase letters.

When you type the caller's password in the Password text box, the characters that you type appear as bullets to prevent others from learning your password.

3 **Press Tab, then type your password again in the Reenter Password text box, exactly as you did the first time, to verify that you entered the password correctly.**

You must type the caller's password *exactly* as you did before, including the use of uppercase and lowercase letters. Typing the password again confirms that you have entered it correctly.

4 **Type the phone number of the calling router in the Phone Number text box.**

5 **To select tone dialing, click the Tone button. Or, to select pulse dialing, click the Pulse button.**

6 **To activate the DialUp port, select the Active button. To deactivate the DialUp port, select the Inactive button.**

When you first configure a port, its status is active by default. When the router is running, it routes data packets through all active ports. You can change the status of the DialUp port from active to inactive at any time.

7 **When you have finished specifying the DialUp port information, click Define to close the DialUp Port Info dialog box.**

6 Tunneling Through Foreign Network Systems

Tunneling allows you to connect two or more native local area networks (LANs) or internets through a foreign network system or half-routing link, providing wide area connectivity. The Apple Internet Router allows *native* networks or internets, which communicate using AppleTalk protocols, to connect with one another through a tunnel built on a *foreign network system,* which uses some other protocol family. This chapter provides a general description of the tunneling capabilities of the Apple Internet Router.

The AppleTalk/IP Wide Area Extension, which you can purchase separately, allows two or more AppleTalk networks or internets to communicate through a tunnel built on a TCP/IP network. For information about configuring an IP tunneling port, see *Using the AppleTalk/IP Wide Area Extension.*

A *tunnel* connecting AppleTalk networks or internets functions as a single virtual data link between those networks or internets. Figure 6-1 shows several AppleTalk internets connected with one another through a tunnel.

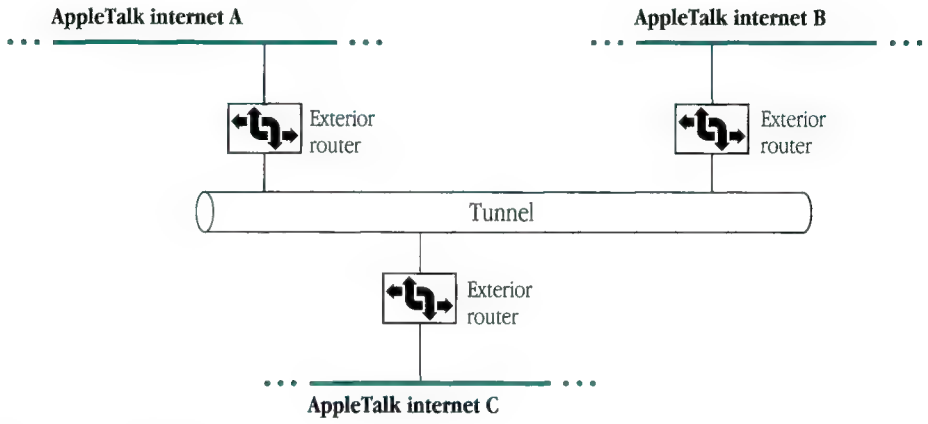


Figure 6-1 Tunneling

Exterior routers

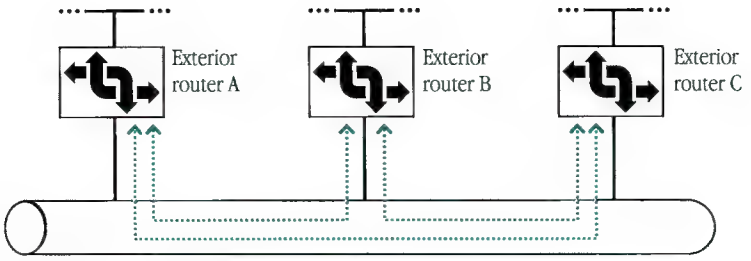
An *exterior router* is an AppleTalk router with one or more ports connected to an AppleTalk network or internet, *and* one or more ports connected to either a foreign network system or a half-routing link. Thus, an exterior router is a node on both an AppleTalk network or internet, and on a foreign network system. In Figure 6-1, an exterior router connects each AppleTalk internet to the tunnel, allowing the AppleTalk internets to communicate with one another through the tunnel. Exterior routers use a foreign network system *only* to connect with one another and do not provide connectivity to the foreign network system.

An exterior router first encapsulates AppleTalk packets in packets for a foreign network system, then sends those packets through the foreign network system to the exterior router that is the next forwarding router. That exterior router decapsulates the packets, then forwards them to their destination AppleTalk networks.

Fully connected and partially connected tunnels

Generally, all exterior routers on a tunnel through a foreign network system can communicate with one another. An exterior router on a tunnel sends the routing information for *only* its local internet to other exterior routers on the tunnel. It does not forward routing information obtained from other exterior routers on the tunnel, because the other exterior routers exchange their own routing information.

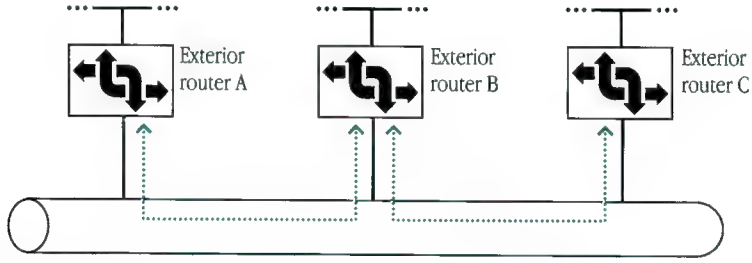
If all exterior routers connected to a tunnel are aware of and can communicate with one another, that tunnel is *fully connected.* Figure 6-2 shows a fully connected tunnel on which all of the connected exterior routers can communicate.



The arrows show which exterior routers can communicate with one another.

Figure 6-2 A fully connected tunnel

If some of the exterior routers on a tunnel *cannot* communicate with one another, that tunnel is only *partially connected.* For example, in Figure 6-3, exterior router A and exterior router C cannot communicate with one another.



The arrows show which exterior routers can communicate with one another.

Figure 6-3 A partially connected tunnel

You can create a partially connected tunnel to provide network-level security. However, it is also possible to create a partially connected tunnel inadvertently. An exterior router cannot ascertain whether a tunnel is fully connected or partially connected. If networks that should be present on the internet are not listed in the Network Information window in Router Manager, see Chapter 10, "Troubleshooting."

7 Configuring the Wide Area Routing Options

This chapter describes some of the wide area routing capabilities of the Apple Internet Router. It explains how to configure a half-routing or tunneling port to

- resolve numbering conflicts by remapping remote network numbers
- cluster remapped network numbers
- allow routing distances greater than 15 hops
- cause network traffic to traverse a redundant path, by designating a port as a backup path or by increasing the routing distance through a port
- hide networks

Resolving numbering conflicts by remapping remote network numbers

Each network in a wide area network (WAN) must have a unique network number or range. While a half-routing link or tunnel may connect different parts of a single organization's internet, it often connects an internet that spans many different organizations. If each organization on a large, global WAN administrates its internet independently, conflicting network numbers or ranges may exist. The Apple Internet Router can automatically remap remote network numbers or ranges on half-routing and tunneling ports to resolve network-numbering conflicts. Thus, if network-number remapping is enabled, you need not reconfigure the network numbers or ranges on either part of the internet to resolve network-numbering conflicts.

When configuring a half-routing or tunneling port, you can specify a range of AppleTalk network numbers into which the router can remap the network numbers or ranges for networks accessible through that port. This *remapping range*—the range of network numbers reserved for network-number remapping—must not conflict with any network numbers or ranges already in use on the router's local internet. The router maps the network numbers or ranges in incoming data packets into the remapping range, then maps remapped network numbers or ranges in outgoing packets back to their actual network numbers or ranges. To routers and other devices within the router's local internet, the packets seem to originate from networks having numbers in the remapping range.

To prevent routers that connect networks that have conflicting network numbers or ranges from encountering network-numbering conflicts, you must configure *all* exterior routers to remap network numbers.

△ **Important** Avoid creating an internet layout in which redundant paths exist between two internets that are connected through a half-routing or tunneling port on which network-number remapping is enabled. *Redundant paths* exist when a router in one internet is connected to a router in another internet and both internets are connected through a third router, as shown in Figure 7-1. If no redundant paths exist, the router will activate the port when it starts up and the port will remain active.

At startup, if the router detects that the activation of a tunneling port on which network-number remapping is enabled would create a routing loop, it prevents that port from being

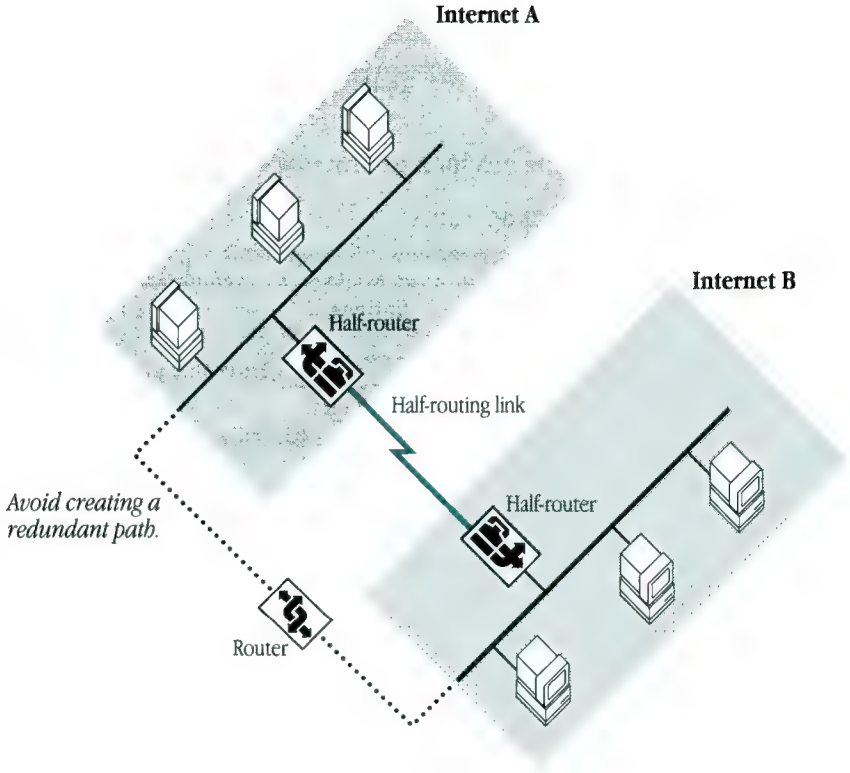


Figure 7-1 Avoiding redundant paths on tunneling ports

activated. If the router detects a loop while the router is running and network-number remapping is enabled on the tunneling port creating the loop, it deactivates that port. This prevents any packets containing remapped network numbers from looping back to the router that originally remapped those network numbers. If this occurred, it would appear to the remapping router that the remapped network numbers identified other networks. Occasionally, when clustering is also active, a router may be unable to detect a loop. For information about clustering, see the section "Clustering Remapped Networks" later in this chapter.

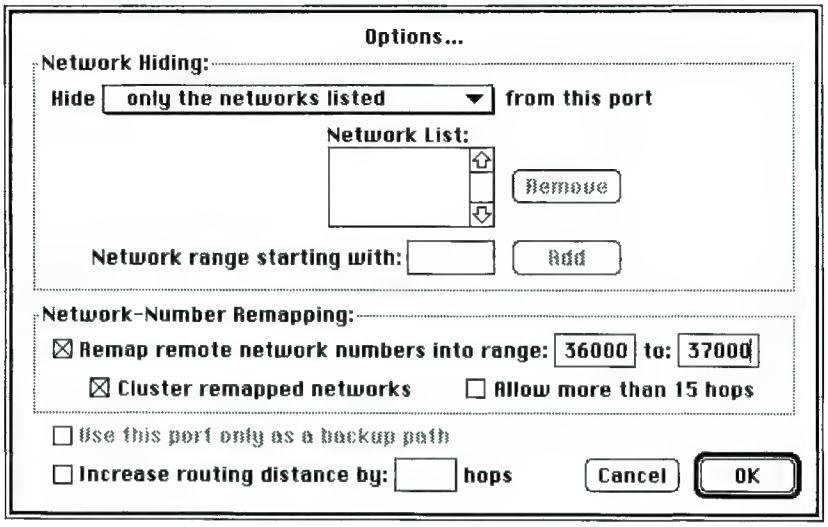
If the router allowed a port on which network-number remapping were enabled to create a loop, when that router received packets containing remapped network numbers, it would remap the network numbers again and again, until the number of times the packets containing the remapped network numbers traversed the loop had exceeded the maximum routing distance of 15 hops. △

Remapping remote network numbers

To turn on network-number remapping, follow these steps:

1 In the Port Info dialog box for a half-routing or tunneling port, click Options.

The Options dialog box appears.



2 Select the "Remap remote network numbers into range" checkbox to turn on network-number remapping.

Once you turn on network-number remapping, you must specify a range of network numbers into which remote network numbers are to be remapped.

To turn off network-number remapping, deselect the "Remap remote network numbers into range" checkbox. If you are turning network-number remapping off, skip steps 3 and 4.

3 Type the lowest network number in the range in the "Remap remote network numbers into range" text box.

4 Type the highest network number in the range in the "to" text box.

5 Click OK.

Clustering remapped network numbers

Each router on an internet broadcasts a routing table for each of its AppleTalk ports at ten-second intervals, allowing the other routers on the internet to update their routing information. For detailed information about the contents of a routing table, see the section "The Routing Table" in Chapter 9.

Broadcasting the routing tables for a large wide area internet—which might consist of thousands of networks—would generate a significant amount of traffic on the local internet. Therefore, within its local internet, an exterior router can represent remapped network numbers for a remote internet connected through a half-routing or tunneling port as a *cluster,* or a single extended network consisting of multiple zones. A cluster requires only *one* entry in a routing table. Thus, clustering minimizes the amount of *routing traffic* generated on the local internet—that is, traffic caused by the broadcasting of routing information—by devices on networks connected through half-routing or tunneling ports. Clustering also minimizes storage requirements for routing information on other routers on the local internet.

A router on which clustering is enabled automatically clusters remapped networks in an internet. For example, a router might create one cluster for each other router connected to a half-routing link or tunnel. A cluster can include up to 255 zones.

As shown in Figure 7-2, if networks in an internet had the network ranges 1–10, 100–200, and 1000–1005, and a router connected to a different part of the internet received these network ranges through a half-routing or tunneling port, that router might remap these network ranges to 241–250, 251–351, and 352–357, respectively. Within its local internet, the remapping router might then represent the three networks as a single extended network, or cluster, with a network range from 241 to 357. The router would associate all of the zones in the three networks with the cluster.

Half-router B remaps, then clusters these network ranges.

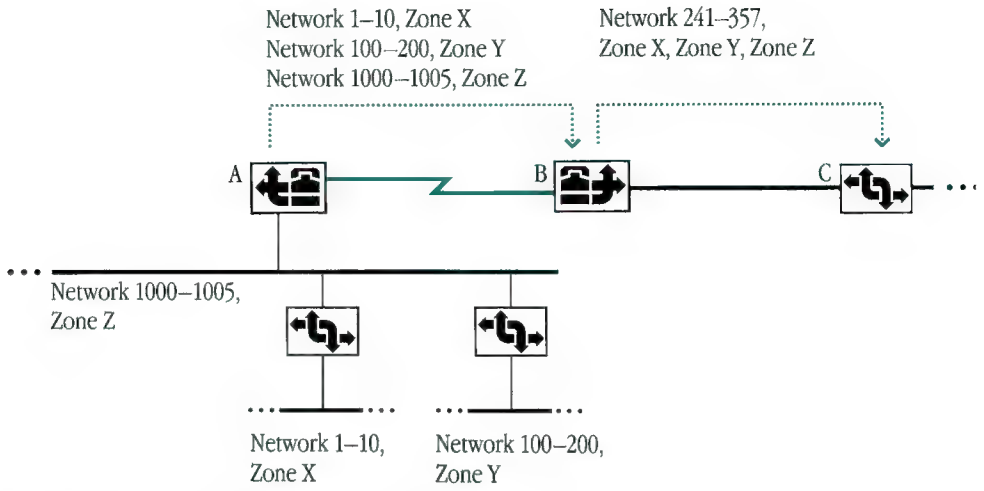


Figure 7-2 Clustering remapped network numbers

To turn on clustering, follow these steps:

1. **In the Port Info dialog box for a half-routing or tunneling port on which network-number remapping is enabled, click Options.**

   The Options dialog box appears.

2. **Select the "Cluster remapped networks" checkbox to turn on clustering.**

   To turn off clustering, deselect the "Cluster remapped networks" checkbox.

3. **Click OK.**

Some constraints exist on clustering:

- You can cluster *only* remapped network numbers. If noncontiguous network numbers—for example, 1, 1001, and 20345—were not remapped before being clustered, all other numbers within the existing range of numbers would remain unused.
- All networks in a cluster appear to be the same number of hops away.

- The routing information for a cluster is static. Thus, if a network that is part of a cluster is disconnected or goes down, the router cannot update the zone list for the cluster. The zones for a network that is no longer on the internet would appear in the zone list until all of the networks in that cluster either were disconnected or went down.
- All networks accessible through a half-routing or tunneling port might *not* be in the same cluster. Generally, all networks that are accessible when the router establishes a half-routing link or tunnel are in one cluster. However, networks that become accessible later will be in a different cluster.

Allowing routing distances greater than 15 hops

The distance between two networks in an internet is measured in *hops*. Each hop corresponds to a router. A *hop count* indicates the number of routers through which a data packet must pass to reach its destination network, as illustrated in Figure 7-3.

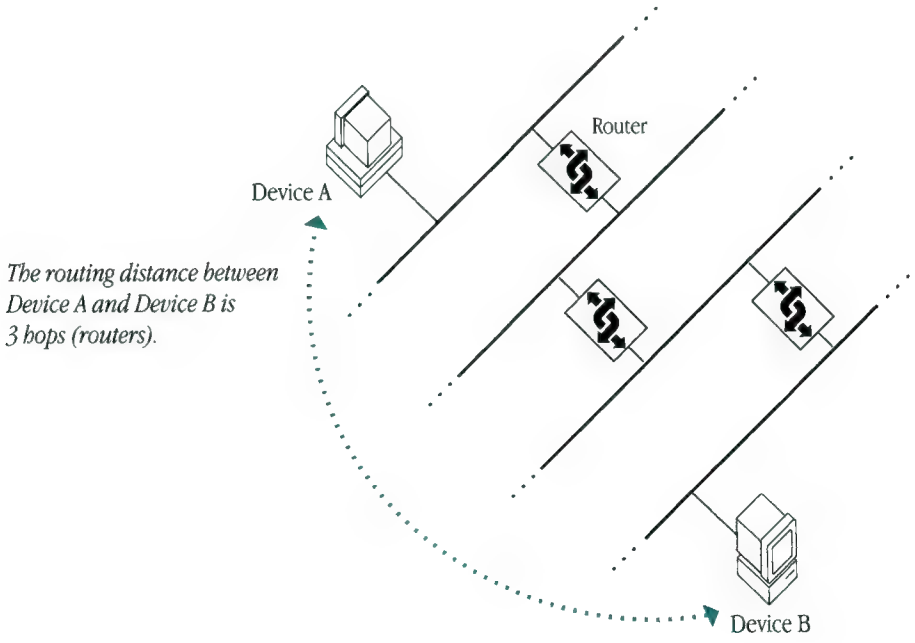


Figure 7-3 Measuring routing distances in hops

AppleTalk protocols allow a maximum of 15 hops. When a half-router or a tunnel connects two networks, the distance over which the resulting internet extends can easily exceed 15 hops. To allow the creation of larger internets, you can configure a half-routing or tunneling port on which network-number remapping is enabled to allow routing distances greater than 15 hops through *hop-count reduction.* When hop-count reduction is enabled on a port, all networks accessible out that port appear to be *one* hop away from all AppleTalk networks in the router's local internet.

◆ **Note** To ensure the proper operation of network-number remapping and hop-count reduction, no routing loops can exist across the affected link. The router prevents loops when network-number remapping is enabled. Therefore, whenever network-number remapping is enabled, an exterior router can perform hop-count reduction without any risk of a data packet being forwarded in an infinite routing loop. Hop-count reduction is available *only* when network-number remapping is enabled on a half-routing or tunneling port. ◆

To allow more than 15 hops, follow these steps:

1 **In the Port Info dialog box for a half-routing or tunneling port on which network-number remapping is enabled, click Options.**

The Options dialog box appears.

2 **Select the "Allow more than 15 hops" checkbox to turn on hop-count reduction.**

To turn off hop-count reduction, deselect the "Allow more than 15 hops" checkbox.

3 **Click OK.**

Using redundant paths

Generally, communication over half-routing links or tunnels is much slower than communication within a LAN and can cause significant delays in packet forwarding. If more than one path exists between two networks connected through a half-routing or tunneling port, you can minimize the amount of traffic on the half-routing or tunneling port by

- designating that port as a backup path
- increasing the routing distance through that port

If you do *not* designate the half-routing or tunneling port as a backup path, the router forwards packets over the path having the shortest routing distance. If the routing distances over redundant paths are the same, the router may alternately forward packets over each path. If you do not want the router to forward packets over a half-routing or tunneling port, you can increase the routing distance through that port, making it the path having the longest routing distance.

Designating a port as a backup path

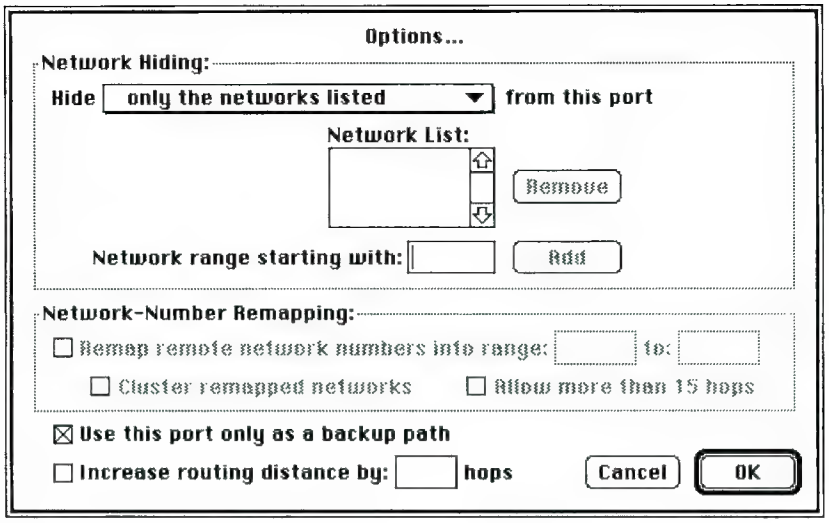
To minimize traffic on a slow half-routing link or tunnel on which network-number remapping is *not* enabled, you can designate that port as a *backup path*. The router uses a backup path to forward AppleTalk data packets only if the primary path to a specific network becomes unavailable. Generally, the router uses a backup path *only* to exchange routing information. To designate a half-routing or tunneling port as a backup path, follow these steps:

1 **In the Port Info dialog box for a half-routing or tunneling port, click Options.**

The Options dialog box appears.

2 **Select the "Use this port only as a backup path" checkbox to designate a port as a backup path.**

To stop using a backup path, deselect the "Use this port only as a backup path" checkbox.



3 Click OK.

△ **Important** Once the router forwards data packets over a backup path, other routers may continue sending some packets over the backup path rather than sending them over the primary path when it again becomes available. To ensure that the routers use only the primary path, you may need to stop the router on which a port is configured as a backup path, wait ten minutes, then restart the router. △

Increasing the routing distance through a port

The Apple Internet Router provides *hop-count weighting* to reduce traffic on slow half-routing links or tunnels. Hop-count weighting effectively increases the routing distance through a port by a specific number of hops. You can assign a hop-count weight to a link between two exterior routers, based on the speed of the link. By increasing the routing distance through a port by a large number of hops, you can cause traffic to traverse a redundant path, if such a path is available and the distance to a network over that path appears to be shorter.

However, you should not increase the routing distance through a port by a number of hops that would cause routing distances to networks accessible through that port to exceed the maximum of 15 hops. Otherwise, the router would be unable to provide full connectivity to all of the networks on the internet unless a redundant path were available.

To increase the routing distance through a half-routing or tunneling port, follow these steps:

1 **In the Port Info dialog box for a half-routing or tunneling port, click Options.**

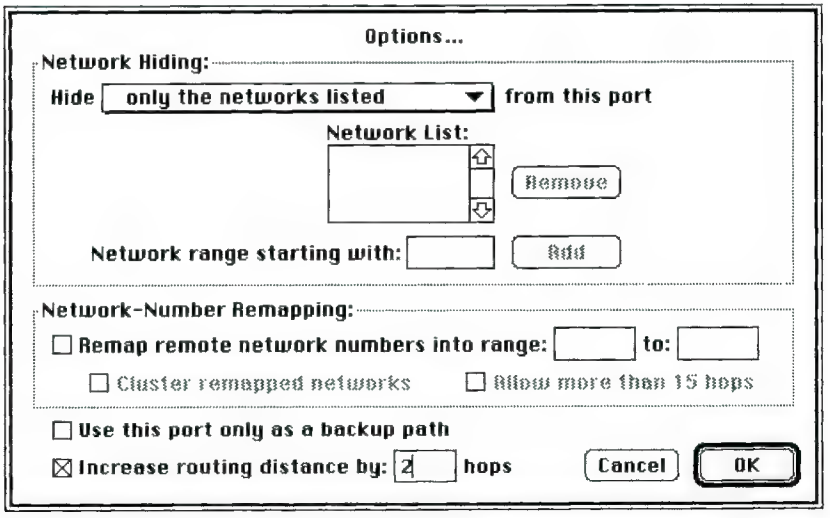
The Options dialog box appears.

2 **Select the "Increase routing distance by" checkbox to turn on hop-count weighting.**

Once you turn on hop-count weighting, you must specify the number of hops by which to increase the routing distance.

To turn off hop-count weighting, deselect the "Increase routing distance by" checkbox. If you are turning hop-count weighting off, skip step 3.

3 **Type the number of hops by which to increase the routing distance in the "Increase routing distance by" text box.**



4 Click OK.

Hiding networks in an internet

The Apple Internet Router provides basic network-level security for large WANs through *network hiding*.

When configuring a half-routing or tunneling port on the router, you can specify that certain networks or all networks connected to other ports on the router be hidden from or shown to other routers connected to that port. Devices on a part of the internet from which a network is hidden cannot access the devices on the hidden network. The names of devices on hidden networks do *not* appear in the Chooser on computers in the parts of an internet from which a network is hidden.

△ **Important** Devices on a hidden network cannot access devices on the parts of the internet from which the network is hidden, as shown in Figure 7-4. △

Half-router A hides Network 22 from Internet B.

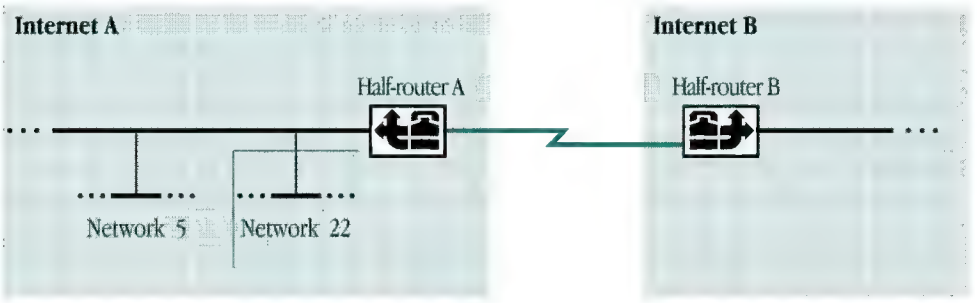

Internet A
Half-router A
Network 5
Network 22
Internet B
Half-router B
Devices on Network 22 cannot access devices on Internet B.
Devices on Internet B cannot access devices on Network 22.

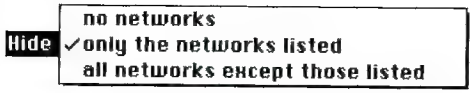
Figure 7-4 Network hiding

To hide or show a network connected to a half-routing or tunneling port, follow these steps:

1 **In the Port Info dialog box for a half-routing or tunneling port, click Options.**

The Options dialog box appears.

2 **Select an option in the Hide pop-up menu to specify whether networks are to be hidden and how to list the networks.**



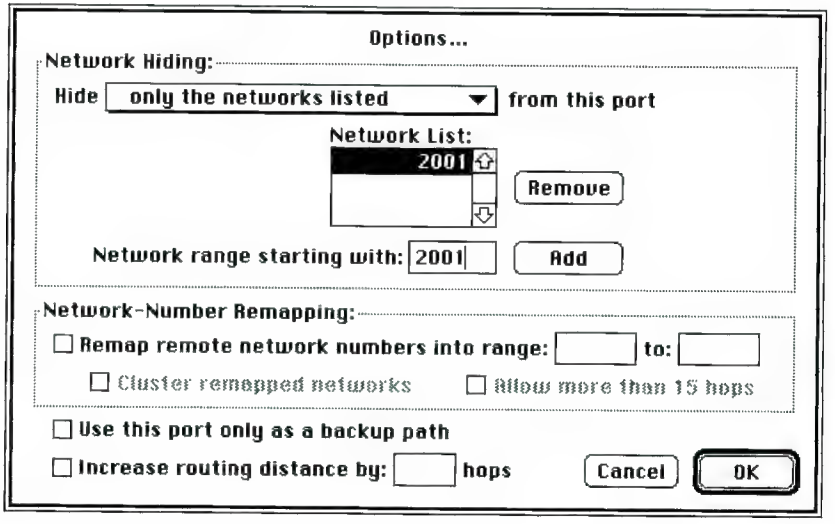
In the Hide pop-up menu, "only the networks listed" is selected by default. If you select "all networks except those listed," only the zones and devices associated with the networks that you add to the network list will appear in the Chooser.

If you selected "no networks," skip steps 3 through 5.

3 To specify the network number or range of a network to be hidden or shown, type the network number or the first network number in the range in the "Network range starting with" text box.

4 Click Add.

The network number appears in the list of network numbers.



5 To hide or show additional networks, repeat steps 3 and 4 for each network.

6 Click OK.

8 Modifying the Router's Setup

Using Router Manager, you can activate and deactivate ports at any time. However, to modify a setup document or change the router's startup options, you must first stop the router. You can start, stop, or reconfigure the router without restarting the router Macintosh.

This chapter explains how to

- change the router's zone
- enter an administrator's password to open Router Manager
- activate and deactivate ports
- stop the router
- modify setup documents and port configurations
- designate a different setup document as the startup document and change the router's other startup options
- customize views of setup windows
- change the administrator's password
- remove password protection from Router Manager

Changing the router's zone

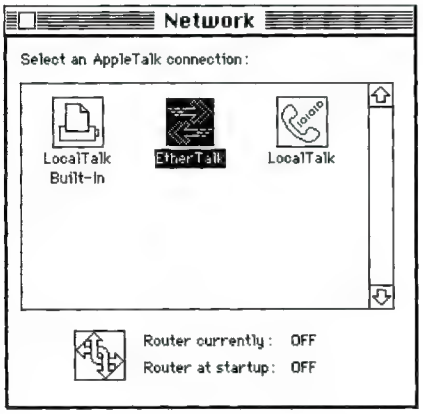
If you designated an AppleTalk connection other than LocalTalk as the user port for the router Macintosh, you can change the zone in which the router Macintosh resides at any time. To change its zone, follow these steps:

1 **Choose Control Panels from the Apple menu.**

The Control Panels window appears.

2 **In the Control Panels window, double-click the Network icon to open the Network control panel.**

The Network control panel appears.



3 **In the Network control panel, click the AppleTalk connection that is currently highlighted.**

A message asks you to select an AppleTalk zone.

4 **Select a zone from the list of available AppleTalk zones, then click OK.**

The router Macintosh remains in this zone until you change the router's AppleTalk connection or select a different zone for the router.

5 **Close the Network control panel.**

Entering your password to open Router Manager

Once you have set an administrator's password, you must thereafter enter your password to open Router Manager to change a setup document, the status of either a port or the router, or the router's startup options. To enter the administrator's password when opening Router Manager, follow these steps:

1 **Double-click the Router Manager icon.**

Alternatively, if the router is *not* running, you can double-click a setup document's icon to open Router Manager.

The following dialog box appears.

2 **Type the administrator's password in the Password text box.**

You must type your password *exactly* as you did when setting your password, including your use of uppercase and lowercase letters.

3 **Click OK.**

Router Manager opens. If the router is not running and you opened Router Manager by double-clicking a setup document's icon, that setup document also opens.

Activating and deactivating ports

When the router is running, it routes data packets through all active ports. You can change the status of a port—to active or inactive—either when the router is running *or* when the router is off. When you first configure a port, its status is active by default. To change the status of a port, follow these steps:

1 **Open a setup document.**

2 **In the setup window, double-click an access method to open a Port Info dialog box.**

3 **In the Port Info dialog box, change the port's status.**

- To activate a port that is currently inactive, click the Active button.
- To deactivate a port that is currently active, click the Inactive button.

△ **Important** You can deactivate the user port when the router is running. However, deactivating the user port interrupts users' access to any network services running concurrently on the router Macintosh. Users cannot access those services until you reactivate the user port. △

4 **Click Define to close the Port Info dialog box.**

If the router is running, the change that you made to the port status is effective only until you next stop the router. If you want to change the port status temporarily, you are done.

If the router is *not* currently running, you can change the port status permanently, as described in step 5.

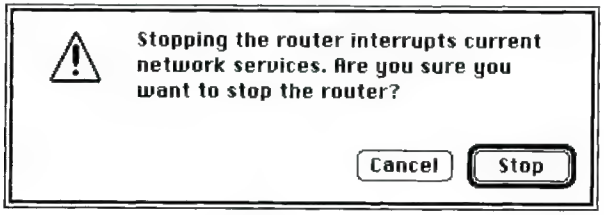
5 **If the router is not running, choose Save from the File menu to save your changes to the setup document, permanently changing the port's status.**

Stopping the router

You cannot modify setup documents when the router is running. To modify a setup document, you must first stop the router. To stop the router, follow these steps:

1 Choose Stop Router from the Control menu.

The following alert box appears.



2 Click Stop to confirm that you want to stop the router.

When the router stops running, the Stop Router command changes to Start Router. The router status indicator in the Network control panel indicates that the router is currently off.

Once you stop the router, you can modify the startup document or any other setup document, create a new setup document, or designate a different setup document as the startup document.

Modifying a setup document

You can modify an existing setup document once you stop the router. To open a setup document, choose Open from the File menu. The setup document appears on the desktop.

Adding or changing a port configuration

When the router is not running, you can add port configurations to a setup document or change a port configuration in a setup document. To configure another port or change a port configuration, follow these steps:

1 **In a setup window, double-click an access method to open a Port Info dialog box.**

2 **In the Port Info dialog box, configure the port or change the existing port information.**

For instructions on how to configure the port or change the existing port information, see the following sections:

- To configure a LocalTalk port, see the sections "Configuring a LocalTalk Port" and "Hiding Devices on an Internet" in Chapter 4 of this guide.
- To configure an EtherTalk or TokenTalk port, see the sections "Configuring an EtherTalk or TokenTalk Port" and "Hiding Devices on an Internet" in Chapter 4 of this guide.
- To configure a half-routing port, see "Configuring a Half-Routing Port" in Chapter 5 of this guide; and "Configuring the Wide Area Routing Options" in Chapter 7 of this guide.
- To configure an IP tunneling port, see *Using the AppleTalk/IP Wide Area Extension* and "Configuring the Wide Area Routing Options" in Chapter 7 of this guide.
- To configure an X.25 port, see *Using the AppleTalk/X.25 Wide Area Extension* and "Configuring the Wide Area Routing Options" in Chapter 7 of this guide.

3 **Click Define to close the Port Info dialog box.**

4 **Save your changes to the setup document.**

Changing a network number or range

Once you assign a network number or range to an AppleTalk network and run the router, you should avoid changing that network number or range, if possible. The network number or range that you specify for an AppleTalk network appears in the routing tables in all routers on the internet.

△ **Important** Changing a network's number or range can cause errors in internet routing to and from devices on that network. When you start up a device, it acquires its network number or network range from the router. If you change a network's number or range, you *must* restart all devices on that network to enable them to acquire the new number or range. Otherwise, the devices on that network will not have the correct network number or range. △

To change a network number or range, follow these steps:

1 **Stop all routers connected directly to the network for which you are changing the network number or range to avoid conflicts.**

While the routers connected directly to the network for which you are changing the network number or range are stopped, the devices on that network cannot access services on other networks, nor can other devices on the internet access services on that network.

2 **In the Port Info dialog box, change the network number or range.**

For instructions on how to specify a different network number, see the section "Configuring a LocalTalk Port" in Chapter 4. For instructions on how to specify a different network range, see the section "Configuring an EtherTalk or TokenTalk Port" in Chapter 4.

3 **Click Define to close the Port Info dialog box.**

4 **Save your changes to the setup document.**

5 **Repeat steps 2 through 4 for all seed routers connected directly to the network for which you are changing the network number or range.**

△ **Important** If more than one router is a seed router for a network, you must specify *exactly* the same network number or range when configuring the seed port on each seed router connected to that network. △

6 **After the routers have been off for at least ten minutes, restart the routers.**

The delay purges the network's old network number or range from the routing tables in all routers on the internet, allowing the routers to acquire the network's new network number or range when you restart them.

Changing a zone name or zone list

The zone name or zone list that you specify for an AppleTalk network appears in the routing tables in all routers on the internet and in the Chooser on each Macintosh on the internet. You should notify network users of any changes made to zone names or zone lists. To change a zone name or zone list, follow these steps:

1 **Stop all routers connected directly to the network for which you are changing the zone name or zone list to avoid conflicts.**

While the routers connected directly to the network for which you are changing the zone name or zone list are stopped, the devices on that network cannot access services on other networks, nor can other devices on the internet access services on that network.

2 **In the Port Info dialog box, change the network's zone name or zone list.**

For instructions on how to change a zone name, see the section "Configuring a LocalTalk Port" in Chapter 4. For instructions on how to change a zone list, see the section "Configuring an EtherTalk or TokenTalk Port" in Chapter 4.

△ **Important** Before merging two existing zones—by giving one zone the same name as another zone—verify that all network services of the same type within the two zones have different names. △

3 Click Define to close the Port Info dialog box.

4 Save your changes to the setup document.

5 Repeat steps 2 through 4 for all seed routers connected directly to the network for which you are changing the zone name or zone list.

△ **Important** If more than one router is a seed router for a network, you must specify *exactly* the same zone name or zone list when configuring the seed port on each seed router connected to that network. You can add zone names to a zone list in any order. The default zone for a network must be the same on all seed routers connected to the network. △

6 After the routers have been off for at least ten minutes, restart the routers.

The delay purges the network's old zone name or zone list from the routing tables in all routers on the internet, allowing the routers to acquire the network's new zone name or zone list when you restart them.

Removing a device from a list of hidden devices

When reconfiguring an AppleTalk port, you can remove a device from a list of hidden devices by following these steps:

1 In the Hide Devices dialog box, select the item to be removed from the device list.

2 Click Remove.

The item no longer appears in the device list.

3 Click OK.

4 Save your changes to the setup document.

Removing a network from a list of hidden networks

When reconfiguring a half-routing or tunneling port, you can remove a network number from a list of hidden networks by following these steps:

1. In the Options dialog box, select the network number to be removed from the network list.
2. Click Remove.

   The network number no longer appears in the list of network numbers.
3. Click OK.
4. Save your changes to the setup document.

Removing a port configuration

When the router is not running, you can remove an existing port configuration. To remove a port configuration, follow these steps:

1. In a setup window, select an access method.
2. Choose Clear Port Info from the Edit menu.

   Any information previously specified in the Port Info dialog box for the selected access method is cleared.
3. Save your changes to the setup document.

Using a different startup document

Router Manager allows you to create multiple setup documents. When the router is not running, you can select a different setup document for the router to use at startup. To select a different startup document, follow the instructions in the section "Selecting a Startup Document" in Chapter 3.

Changing other router-startup options

When the router is not running, you can change any of the settings in the Set Startup dialog box. You can turn the options "Activate router at Macintosh startup" and "Cancel router startup if an error occurs" on or off. You can also specify the maximum sizes of routing tables and zone tables. For instructions on how to set these options, see the section "Configuring the Router for Startup" in Chapter 3.

Customizing your view of a setup window

Router Manager allows you to control the display of information in a setup window. Once you choose a view, Router Manager uses that view until you choose a different view.

Displaying a detailed or summary view

You can choose a detailed or summary view of a setup window. By default, Router Manager displays a detailed view of a setup window. In the View menu, a checkmark indicates the view that is currently selected.

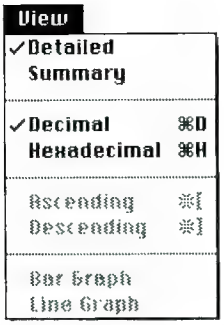


Figure 8-1 The View menu

To see a detailed view of a setup window, choose Detailed from the View menu. A detailed view of a setup window provides the following information:

- all of the router's physical ports
- all access methods available for each physical port
- a port description, the current status, and the current settings for each port

To see a summary view of a setup window, choose Summary from the View menu. A summary view of a setup window lists only the physical ports and access methods that have been configured.

Setting the numeric display format

You can choose a decimal or hexadecimal numeric display format for the network numbers and ranges displayed in a setup window. By default, Router Manager displays network numbers and ranges in decimal numbers. In the View menu, a checkmark indicates the view that is currently selected.

To display network numbers and ranges in decimal numbers, choose Decimal from the View menu. To display network numbers and ranges in hexadecimal numbers, choose Hexadecimal from the View menu.

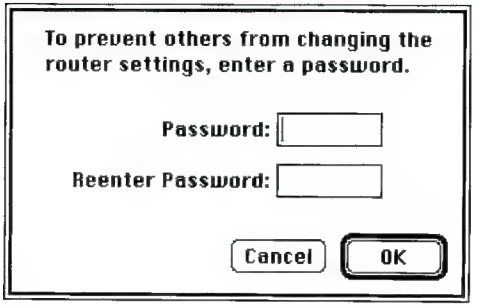
You can specify network numbers and network ranges as either decimal or hexadecimal numbers, regardless of the current numeric display format. Router Manager converts all numbers to the current format. In Router Manager, a *$* character must precede hexadecimal numbers.

Changing the administrator's password

To change the administrator's password, follow these steps:

1 **Choose Set Password from the Control menu.**

The following dialog box appears.



2 **Type your new password in the Password text box.**

You can use a maximum of eight characters in your password, and can use uppercase and lowercase letters to distinguish passwords. The characters that you type appear as bullets to prevent others from learning your password.

3 **Press Tab to move to the Reenter Password text box, then type your new password again in the Reenter Password text box, exactly as you did the first time.**

You must type your password *exactly* as you did before, including your use of uppercase and lowercase letters. Typing your password again confirms that you have entered it correctly.

4 **Click OK to change your password.**

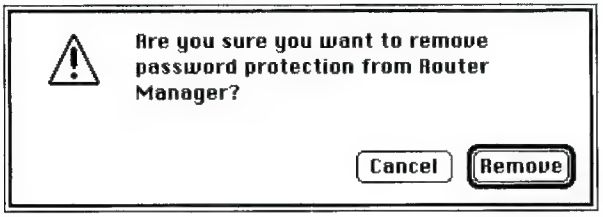
You must enter your password whenever you subsequently open Router Manager. You must type your password *exactly* as you did when setting your password, including your use of uppercase and lowercase letters.

Removing password protection

To remove password protection from Router Manager, follow these steps:

1 **Choose Remove Password from the Control menu.**

The following alert box appears.



2 **Click Remove to verify that you want to remove password protection.**

You no longer have to enter an administrator's password to open Router Manager.

9 Monitoring the Router

Router Manager allows you to monitor the operation of the Apple Internet Router. The Apple Internet Router also supports the Simple Network Management Protocol (SNMP), which allows a network administrator working at a remote computer to obtain statistical and other information from the router.

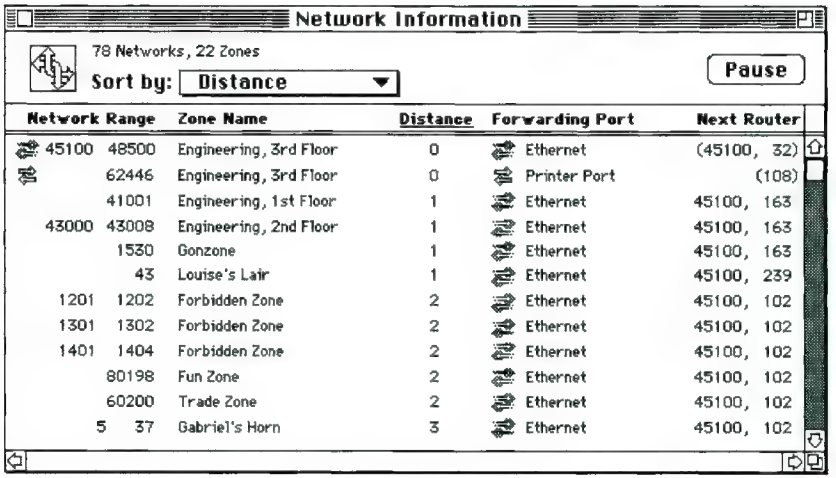
This chapter explains how to use Router Manager to monitor network routing information, router statistics, and port statistics—including routing activity, network reliability, and network errors—when the router is running.

When monitoring router operation, you can open multiple windows concurrently—including the setup window for the startup document, the Network Information window, the Router Statistics window, the Port Statistics window, and the Router Log.

Monitoring network routing information

The Network Information window displays a routing table, which contains the current routing information for the entire internet. As described in the sections that follow, you can display a detailed or summary view of the routing information, display network numbers and ranges as either hexadecimal or decimal numbers, sort the routing information, and temporarily prevent the display from being updated. Once you choose a view of the routing information, Router Manager uses that view until you choose a different view.

When the router is running, choose Network Information from the Windows menu to display the current routing information for the network. The Network Information window appears.



Network Range		Zone Name	Distance	Forwarding Port	Next Router
45100	48500	Engineering, 3rd Floor	0	Ethernet	(45100, 32)
	62446	Engineering, 3rd Floor	0	Printer Port	(108)
	41001	Engineering, 1st Floor	1	Ethernet	45100, 163
43000	43008	Engineering, 2nd Floor	1	Ethernet	45100, 163
	1530	Gonzone	1	Ethernet	45100, 163
	43	Louise's Lair	1	Ethernet	45100, 239
1201	1202	Forbidden Zone	2	Ethernet	45100, 102
1301	1302	Forbidden Zone	2	Ethernet	45100, 102
1401	1404	Forbidden Zone	2	Ethernet	45100, 102
	80198	Fun Zone	2	Ethernet	45100, 102
	60200	Trade Zone	2	Ethernet	45100, 102
5	37	Gabriel's Horn	3	Ethernet	45100, 102

Figure 9-1 The Network Information window

The Network Information window displays the current numbers of networks in and zones on the internet.

The routing table

The router maintains an internal *routing table,* consisting of entries that represent the shortest path to each destination network on an internet. Whenever the router receives routing information from other routers on the internet, it updates its routing table to reflect any changes to the internet—such as networks added to or removed from the internet.

◆ **Note** If the router is not a seed router for a network, it can display that network's routing information in the Network Information window only after it obtains that information from a seed router on that network. Thus, once the routers on a network exchange their routing tables and the router receives the routing information for a network that is connected to a nonseed port from a seed router for that network, the router can send packets to that network.

The router displays network ranges and zone lists for networks that are connected to half-routing and tunneling ports after it remaps and clusters the network numbers. ◆

The routing table displayed in the Network Information window lists the current routing information for each destination network and zone on the internet. Each entry includes the following information about a destination network:

- *Network Range* The network number or range of network numbers assigned to a destination network. If a network is connected directly to the router, an icon at the left of the network range indicates the access method for the port to which the network is connected.
- *Zone Name* The zone name for a destination network.
- *Distance* The routing distance in hops from the router to a destination network. Networks that are connected directly to a router have a routing distance of zero hops.
- *Forwarding Port* The port description for a port through which the router forwards packets to a destination network. An icon at the left of the forwarding port indicates the access method for the forwarding port. Figure 9-2 shows how the router uses a forwarding port to forward packets to the next router for a destination network.
- *Next Router* The node address of the next router in the path to a destination network to which the router is forwarding packets. The next router is on the network connected to the forwarding port.

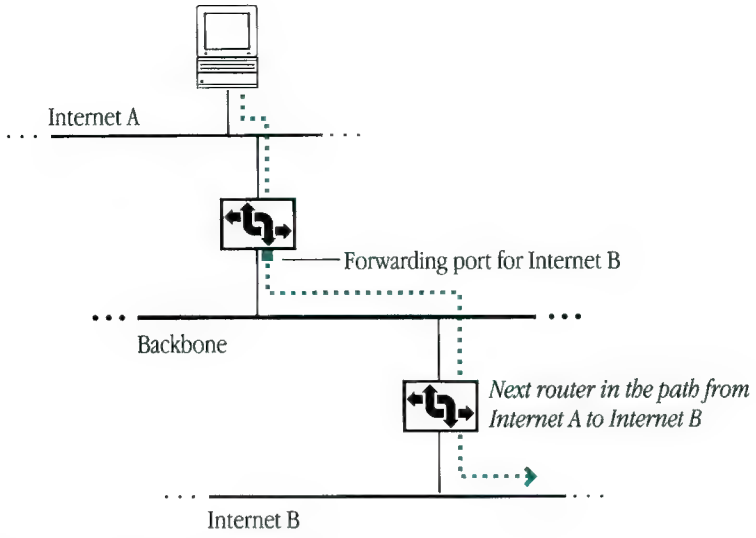


Figure 9-2 A forwarding port

The forwarding port to which the next router is connected determines the type of node address displayed.

- If the forwarding port is a LocalTalk port, the node address of the next router is its node ID. If the next router is that on which Router Manager is running, the node address listed for the next router is that of the forwarding router itself and appears in parentheses.
- If the forwarding port is an EtherTalk or TokenTalk port, the address of the next router consists of its network number and node ID. If the next router is that on which Router Manager is running, the node address listed for the next router is that of the forwarding router itself and appears in parentheses.
- If the forwarding port is a half-routing port, the next router is represented as the phone number to which the port is connecting, if that number is known.
- If the forwarding port is a tunneling port, the next router is represented as an address in the foreign network system on which the tunnel is built, rather than as an AppleTalk address. For more information about IP tunneling ports, see *Using the AppleTalk/IP Wide Area Extension.*

Using the information in the routing table, the router can determine the most efficient path over which to forward a data packet to its destination network.

Displaying a detailed or summary view

You can display either a detailed or summary view of the current routing information in the Network Information window. By default, Router Manager displays a detailed view of the routing information. In the View menu, a checkmark indicates the view that is currently selected.

To see a detailed view of the routing information, choose Detailed from the View menu. A detailed view provides the following routing information for each zone in each network on an internet:

- the network's number or range
- the zone's name
- the distance to the network in hops
- the network's forwarding port
- the next router in the path to the network

To see a summary view of the routing information, choose Summary from the View menu. A summary view of the routing information includes only one entry for each network on an internet. Only the first zone name in each network's alphabetical zone list appears in the summary view. When a network has more than one zone, an ellipsis (...) follows that zone name, indicating that other zones are present.

Setting the numeric display format

You can choose a decimal or hexadecimal numeric display format for network numbers and ranges displayed in the Network Information window. By default, Router Manager displays network numbers and ranges in the routing table in decimal numbers. In the View menu, a checkmark indicates the view that is currently selected.

To display network numbers and ranges in decimal numbers, choose Decimal from the View menu. To display network numbers and ranges in hexadecimal numbers, choose Hexadecimal from the View menu.

You can specify network numbers and network ranges as either decimal or hexadecimal numbers, regardless of the current numeric display format. Router Manager converts all numbers to the current numeric display format. In Router Manager, a *$* character must precede hexadecimal numbers.

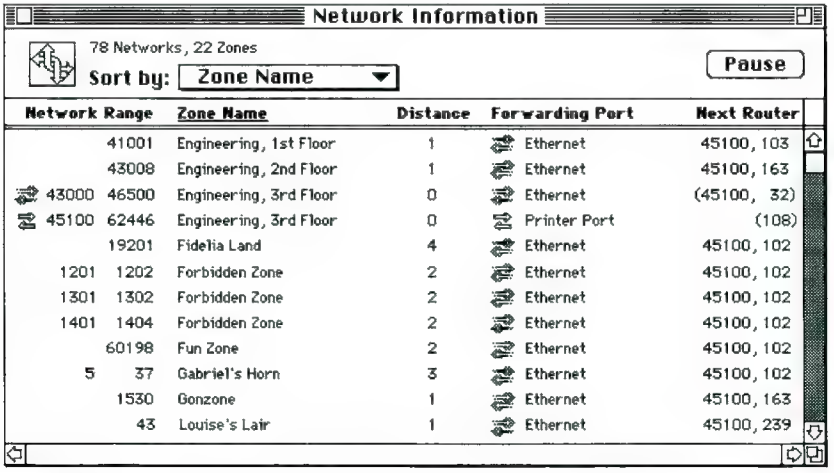
Sorting the routing table

You can select a sort key and a sort direction by which to sort the routing table in the Network Information window.

Selecting a sort key In the Network Information window, you can sort the entries in the routing table by network range, zone name, distance, or forwarding port. By default, the entries are sorted by distance. To sort the routing table using a different sort key, select the type of information by which the routing table is to be sorted in the "Sort by" pop-up menu. A checkmark indicates the type of information by which the routing table is currently sorted.

Figure 9-3 The "Sort by" pop-up menu

The heading of the column containing the type of information by which the routing table is currently sorted is underlined. Figure 9-4 shows the routing table in the Network Information window sorted by zone name.



Network Range		Zone Name	Distance	Forwarding Port	Next Router
	41001	Engineering, 1st Floor	1	Ethernet	45100, 103
	43008	Engineering, 2nd Floor	1	Ethernet	45100, 163
43000	46500	Engineering, 3rd Floor	0	Ethernet	(45100, 32)
45100	62446	Engineering, 3rd Floor	0	Printer Port	(108)
	19201	Fidelia Land	4	Ethernet	45100, 102
1201	1202	Forbidden Zone	2	Ethernet	45100, 102
1301	1302	Forbidden Zone	2	Ethernet	45100, 102
1401	1404	Forbidden Zone	2	Ethernet	45100, 102
	60198	Fun Zone	2	Ethernet	45100, 102
5	37	Gabriel's Horn	3	Ethernet	45100, 102
	1530	Gonzone	1	Ethernet	45100, 163
	43	Louise's Lair	1	Ethernet	45100, 239

Figure 9-4 The routing table sorted by zone name

◆ **Note** Alternatively, you can change the sort key by clicking the heading for the column that contains the type of information by which you want to sort the routing table. ◆

Selecting the sort direction The Network Information window displays the routing information sorted in ascending order by default—that is, from A to Z or from the lowest to the highest number. To sort the routing information in ascending order, choose Ascending from the View menu. If you want to sort the routing information in descending order, choose Descending from the View menu. A checkmark indicates the view that is currently selected.

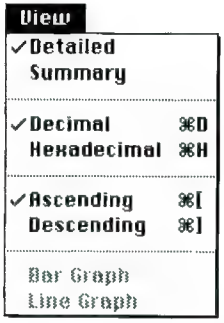


Figure 9-5 The View menu

Freezing the display

To prevent the display of the routing table temporarily from being updated, click Pause. The Pause button changes to Resume. To update the routing table click Resume.

Monitoring network activity and reliability over time

The Router Statistics window displays information about router activity levels, network reliability, and network error rates. It also allows you to control the graphing of that information. You can display router statistics as either bar graphs or line graphs. To open the Router Statistics window, choose Router Statistics from the Windows menu.

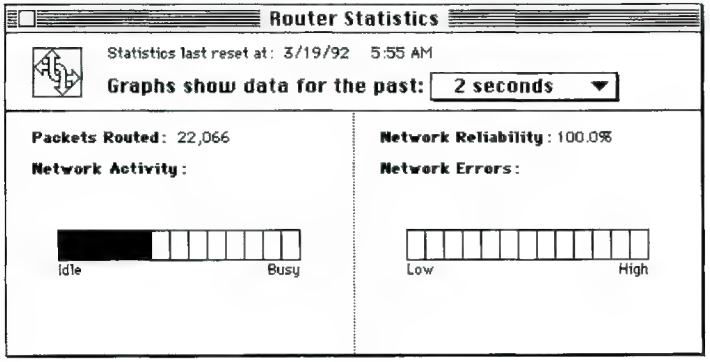


Figure 9-6 The Router Statistics window with bar graphs

The Router Statistics window allows you to monitor the following information:

- *Statistics last reset at* The time and date when the router statistics were last reset or the router was last restarted.
- *Packets Routed* The total number of packets received and forwarded by the router since the router statistics were last reset or the router was last restarted. This total includes only AppleTalk packets passing through the router—not packets generated by nonrouting services on the user port or packets generated by software using AppleTalk routing protocols.
- *Network Activity* The current level of network activity, or traffic, through the router, averaged over the selected period and displayed on a scale of from 0 to 200 packets per second.
- *Network Reliability* The percentage of packets routed successfully, without error.
- *Network Errors* The current level of network errors, which is the proportion of router traffic on which errors occur, averaged over the selected period and displayed on a scale of from 0 to 10 percent.

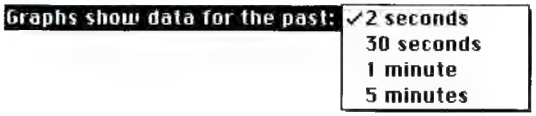
Displaying network activity and error statistics as bar graphs

To display network activity and error statistics as bar graphs, follow these steps:

1 Choose Bar Graph from the View menu.

A checkmark indicates the view currently selected.

2 To specify the period of time represented in the graphs, select a time period in the "Graphs show data for the past" pop-up menu in the Router Statistics window.



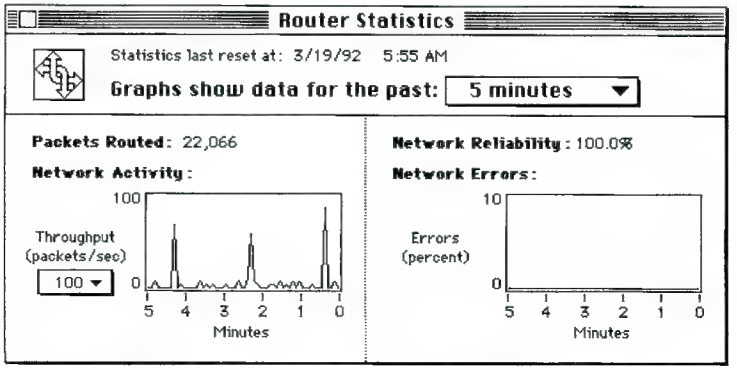
A checkmark indicates the time period currently selected.

Displaying network activity and error statistics as line graphs

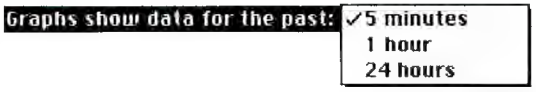
To display network activity and error statistics as line graphs, follow these steps:

1 Choose Line Graph from the View menu.

The Router Statistics window appears as shown in the following figure.



2 To specify the period of time represented in the graphs, select a time period in the "Graphs show data for the past" pop-up menu in the Router Statistics window.



A checkmark indicates the time period currently selected.

3 To specify the maximum number of packets per second represented in the Network Activity graph, select a number of packets per second in the Throughput pop-up menu.

A bullet indicates the number of packets per second currently selected.

Monitoring port statistics

The Port Statistics window displays statistics for the ports configured on the router—including various types of operations and errors on the internet. When the router is running, you can choose Port Statistics from the Windows menu to open the Port Statistics window, shown in Figure 9-7.

In addition to listing the statistics for each port configured on the router, the Port Statistics window lists totals for all ports on the router. The values of the port statistics increase from the time that you start the router until you reset the router statistics or stop the router. Statistics for ports that are currently inactive appear in italics. The Port Statistics window also displays the time and date at which the statistics were last reset or the router was last restarted.

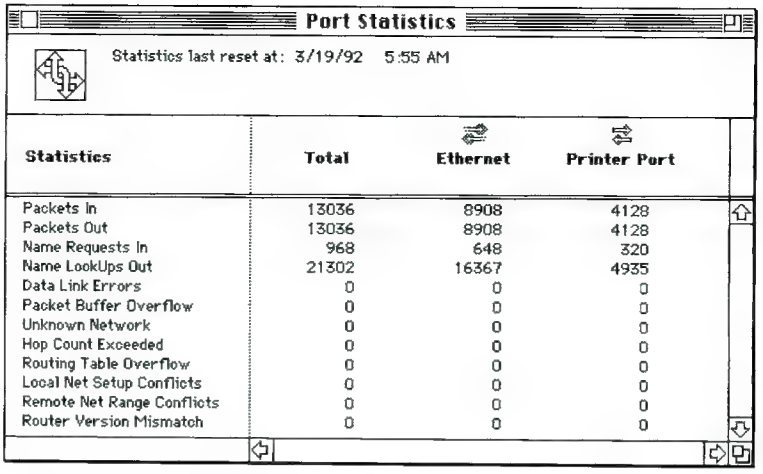

Port Statistics
Statistics last reset at: 3/19/92 5:55 AM
Statistics
Total
Ethernet
Printer Port
Packets In 13036 8908 4128
Packets Out 13036 8908 4128
Name Requests In 968 648 320
Name LookUps Out 21302 16367 4935
Data Link Errors 0 0 0
Packet Buffer Overflow 0 0 0
Unknown Network 0 0 0
Hop Count Exceeded 0 0 0
Routing Table Overflow 0 0 0
Local Net Setup Conflicts 0 0 0
Remote Net Range Conflicts 0 0 0
Router Version Mismatch 0 0 0

Figure 9-7 The Port Statistics window

Monitoring incoming and outgoing traffic

In the Port Statistics window, you can monitor incoming and outgoing traffic on each port or on the router as:

- *Packets In* The total number of packets received for forwarding by the router since the statistics were last reset or the router was last restarted, indicating the amount of incoming traffic on a port or on the router.
- *Packets Out* The total number of packets forwarded by the router since the statistics were last reset or the router was last restarted, indicating the amount of outgoing traffic on a port or on the router.

◆ **Note** The totals for Packets In and Packets Out include only AppleTalk packets, *not* packets generated by nonrouting services on the user port or packets generated by software using AppleTalk routing protocols. ◆

- *Name Requests In* The total number of requests for device names generated by end nodes and received through a port or by the router. Name Requests allow end nodes to acquire device names for device lists in the Chooser or in other networking application programs.

- *Name LookUps Out* The total number of name lookups generated by a port or by the router, in response to incoming name requests. When the router receives a Name Request, it generates a Name Lookup for each network having a zone list that contains the zone named in the request.

Monitoring network errors

In the Port Statistics window, you can monitor the following types of network errors on each port or on the router:

- *Data Link Errors* The number of hardware errors encountered on receiving and forwarding packets.
- *Packet Buffer Overflow* The number of packets discarded by the router because the rate at which it received packets exceeded the rate at which it could forward the packets and its packet buffer became full.
- *Unknown Network* The number of packets discarded by the router because it received requests to route packets to networks not listed in its routing table and was unable to forward the packets.
- *Hop Count Exceeded* The number of packets not forwarded by the router because the paths to their destination networks exceeded the maximum routing distance of 15 hops.
- *Routing Table Overflow* The number of routing packets discarded by the router because the number of AppleTalk networks on the internet exceeded the router's current maximum number of routing table entries and the router was unable to add the packets' destination networks to the routing table.
- *Local Net Setup Conflicts* The number of routing packets received by the router that have a different network number or range for the network over which they were sent than that specified in the current setup for the router being monitored. Such setup errors occur when a network is connected directly to two routers and the configurations for the ports to which that network is connected contain conflicting network numbers or ranges.
- *Remote Net Range Conflicts* The number of routing packets received by the router that indicate a routing table maintained by another router contains a network range that conflicts with a network range listed in the routing table in the router being monitored.
- *Router Version Mismatch* The number of routing packets received from another router on the internet that does not support AppleTalk Phase 2.

Resetting router and port statistics

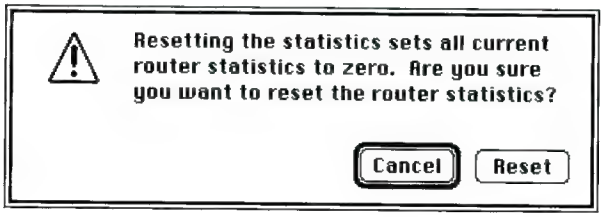
You can reset the statistics that appear in the Router Statistics and Port Statistics windows, including:

- the number of packets routed displayed in the Router Statistics window, which indicates the level of router activity
- the numbers of incoming and outgoing packets displayed in the Port Statistics window, which indicate the amount of traffic over the router
- the numbers of various types of possible network errors displayed in the Port Statistics window
- the time and date when the statistics were last reset displayed in the Router Statistics and Port Statistics windows

The number of packets routed and the other port statistics increase from the time at which you start the router until you reset the statistics or stop the router. To reset the router and port statistics, follow these steps:

1 **Choose Reset Statistics from the Control menu.**

The following alert box appears.


Resetting the statistics sets all current router statistics to zero. Are you sure you want to reset the router statistics?
Cancel
Reset

2 **Click Reset.**

Router Manager resets the number of packets routed and the values of the other port statistics to zero, then again begins increasing their values. It also changes the time and date when the statistics were last reset or the router was last restarted—which is displayed in the Router Statistics and Port Statistics windows—to the current time and date. Resetting the statistics does not affect the graphs in the Router Statistics window.

Exporting information

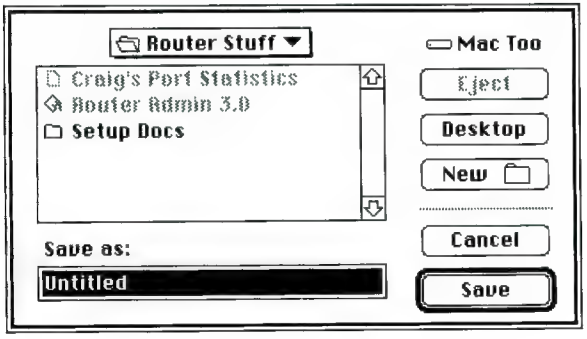
You can save the information in the Network Information and Port Statistics windows as tab-delimited text in a document that various types of application programs can read, including spreadsheet and word-processing programs.

To export the network routing information in the Network Information window or the statistics in the Port Statistics window, follow these steps:

1 **Choose Network Information or Port Statistics from the Windows menu to open the corresponding window.**

2 **Choose Export Data from the File menu to save the information in a text document that has a tab-delimited format.**

The following dialog box appears.



3 **Name and save the document.**

Router Manager saves the text in a tab-delimited format.

Printing

You can print the information displayed in any of the following windows:

- a setup window—including the port information defined in the Port Info dialog box for each port
- the Network Information window
- the Port Statistics window
- the Router Log

10 Troubleshooting

While using Router Manager to set up the router or during router operation, you may encounter problems that require troubleshooting. This chapter gives an overview of the troubleshooting process, which provides an effective strategy for defining, isolating, and solving problems. This chapter also describes how to recognize and solve some problems that you might have with your network, the internet, or the router; and how you can use the Router Log to help you to identify problems.

If you specify invalid or conflicting information when setting up the router, a message informs you about the error and describes how to correct it. Messages also alert you to problems encountered during router operation, whenever possible. This chapter provides additional information about some of the messages that may appear in Router Manager—for example, messages that may require further action to solve a problem or for which there are alternative solutions.

Diagnosing and solving problems

The following steps represent a troubleshooting strategy that can help you to define, isolate, and solve problems with a network, the internet, or the router.

1 Determine the symptoms of the problem.

Gather information from users to define the nature of the problem. If users report more than one problem, define and troubleshoot each problem separately.

2 Ascertain whether the network is the source of the problem.

The network is not the source of the problem if one or more of these conditions exist:

- After disconnecting the network from the device, you can still reproduce the problem on that device.
- A hardware device has failed.
- A user is experiencing the problem only within one application program.
- The problem resulted because a procedure was performed incorrectly by the user.

The network is the source of the problem if one or more of these conditions exist:

- Users cannot access a network service.
- Access to a network service is intermittent.
- One or more devices cannot communicate with other devices.
- Network performance is degraded.

For additional information that can help you to determine whether there is a problem with the network, see the section "Network Problems" later in this chapter.

3 Identify the location of the problem and determine its scope.

Systematically examine progressively smaller components of the network to isolate the problem.

- First, identify what network or networks in the internet are affected by the problem.
- If the problem affects more than one network, determine whether the networks are connected.

- If the problem is isolated to one network, ascertain whether the problem affects more than one device.
- Determine whether there is an excessive amount of traffic between or within specific networks.
- Verify that the network topology is correct.
- Determine whether a network exceeds the maximum cable length or number of devices.
- Determine whether the Macintosh computer on which the router is running or another hardware device is causing the problem.
- Determine whether the router software or other software running on a specific device is causing the problem.

You must determine whether a problem is caused by the network or the router. For additional information that can help you to determine whether the internet or the router is the source of the problem, see the sections "Internet Problems," "Problems With Wide Area Internets," and "Problems With the Apple Internet Router" later in this chapter.

4 **Identify the cause of the problem.**

Once you've isolated the problem to the router or another specific device:

- Verify that its connecting cables are undamaged and connected properly.
- Ascertain whether the router Macintosh or another device is malfunctioning.
- If the hardware is functioning properly, determine whether there is a software problem. If the router is the source of the problem, verify that the router software was installed and set up properly.

For information about various conditions that can cause specific problems with the internet or the router, see the sections "Internet Problems," "Problems With Wide Area Internets," and "Problems With the Apple Internet Router" later in this chapter.

5 **Verify and correct any problem with the network, the router Macintosh or other device, or software running on a device.**

Check the Router Log to verify possible problems with the router. For information about the Router Log, see the section "Using the Router Log to Obtain Information About Router Operation" later in this chapter.

For information about solutions to problems with the internet or the router, see the sections "Internet Problems," "Problems With Wide Area Internets," and "Problems With the Apple Internet Router" later in this chapter.

Network problems

This section describes the symptoms and causes for network problems that can affect the operation of a router.

Missing devices

These symptoms may occur if a device is missing on a network:

- Users are unable to access another zone, another network, a file server, a printer, or the local network.
- Users cannot send electronic mail.
- A device list changes intermittently.

A device may be missing for one of the following reasons:

- The device is not on.
- The device is malfunctioning.
- A break exists in a network connection due to:
  - a defective network interface card
  - a network interface card not seated firmly in its expansion slot
  - a cable disconnected from a connector box
  - a disconnected cable extender
  - a broken cable
  - broken or damaged connector pins
- An inappropriate type of media—such as video or phone cabling—connects devices on the network.

Intermittent access to network services and devices

A device appears intermittently in a device list in the Chooser or another application program.

The number of cyclic redundancy check (CRC) errors that occur is excessive.

Causes	*Solutions*
A network connector is loose.	Reconnect the connector.
A cable extender is loose.	Reconnect the extender to the cable.
A cable is damaged or crimped.	Replace the cable.
The network does not have the proper topology.	Lay out the network properly.
The network is not terminated properly.	Terminate the network as required by the cable type.
The network's cable length exceeds the maximum.	Install a repeater. Subdivide the network with a bridge or router.
The number of devices on the network exceeds the maximum.	Subdivide the network with a bridge or router.
Electromagnetic interference exists.	Reroute twisted-pair or coaxial cable. Replace the cable with fiber-optic cable. Replace the cable with shielded cable.

Degradation of network performance

Users experience delays in network services.

Causes	*Solutions*
An excessive amount of traffic exists on the network.	Ask users to access devices that aren't busy. Subdivide the network with a bridge or router. Add a backbone network. Use a network system that has a faster data transmission rate.
The number of shared services on the network is insufficient—for example, printers or file servers.	Add shared services as needed. Add a print server.
The number of devices on the network exceeds the maximum.	Subdivide the network with a bridge or router.
System software conflicts exist between devices on the network.	Install the same version of the system software on all devices on the network.
Incompatible device drivers—for example, LaserWriter drivers—are installed on devices on the network.	Install the same versions of the device drivers on all devices on the network.
Users are using network services inappropriately.	Ask users to copy application programs from file servers to their own hard disks before opening the programs.
Too many network services are running on a server.	Move one or more services to another server.
Excessive routing distances exist between networks.	Change the placement of routers in the network to reduce the number of hops between a server and devices on other networks that frequently access its services. Add a backbone network.
A virus has infected devices on the network.	Use a virus-protection program to detect and eradicate any viruses.

Using the Router Log to obtain information about router operation

The router records information about its operation in the Router Log, which indicates the router's current status and any errors that prevent the router from running. When the router starts, it records the status of its ports in the Router Log, indicating any errors that prevent a port from being activated. When the router is running, the Router Log provides additional information about errors indicated in the Port Statistics window.

◆ **Note** To prevent the Router Log from being filled with repeated occurrences of the same error, the router does not list all occurrences of a type of error. The router logs an error only when it has not recently encountered an error of the same type—that is, within the last 15 minutes to 1 hour. ◆

To display the Router Log in Router Manager, choose Router Log from the Windows menu. Figure 10-1 shows a Router Log. The most recent entries appear at the top.

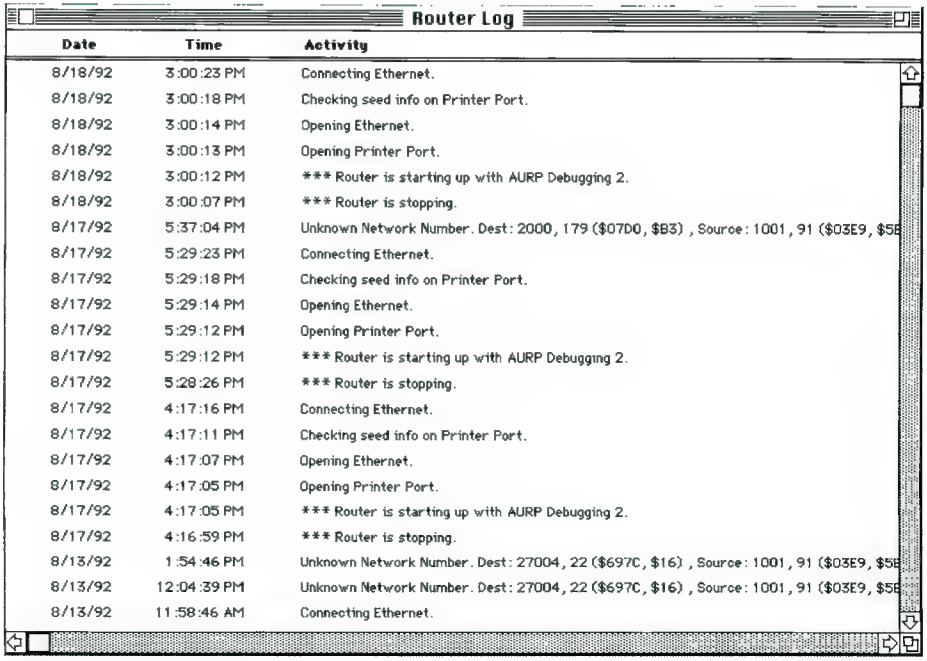

Router Log
Date
Time
Activity
8/18/92 3:00:23 PM Connecting Ethernet.
8/18/92 3:00:18 PM Checking seed info on Printer Port.
8/18/92 3:00:14 PM Opening Ethernet.
8/18/92 3:00:13 PM Opening Printer Port.
8/18/92 3:00:12 PM *** Router is starting up with AURP Debugging 2.
8/18/92 3:00:07 PM *** Router is stopping.
8/17/92 5:37:04 PM Unknown Network Number. Dest: 2000, 179 ($07D0, $B3) , Source: 1001, 91 ($03E9, $5B
8/17/92 5:29:23 PM Connecting Ethernet.
8/17/92 5:29:18 PM Checking seed info on Printer Port.
8/17/92 5:29:14 PM Opening Ethernet.
8/17/92 5:29:12 PM Opening Printer Port.
8/17/92 5:29:12 PM *** Router is starting up with AURP Debugging 2.
8/17/92 5:28:26 PM *** Router is stopping.
8/17/92 4:17:16 PM Connecting Ethernet.
8/17/92 4:17:11 PM Checking seed info on Printer Port.
8/17/92 4:17:07 PM Opening Ethernet.
8/17/92 4:17:05 PM Opening Printer Port.
8/17/92 4:17:05 PM *** Router is starting up with AURP Debugging 2.
8/17/92 4:16:59 PM *** Router is stopping.
8/13/92 1:54:46 PM Unknown Network Number. Dest: 27004, 22 ($697C, $16) , Source: 1001, 91 ($03E9, $5B
8/13/92 12:04:39 PM Unknown Network Number. Dest: 27004, 22 ($697C, $16) , Source: 1001, 91 ($03E9, $5B
8/13/92 11:58:46 AM Connecting Ethernet.

Figure 10-1 The Router Log

When the Router Log is the active window, you can clear the Router Log by choosing Clear Log from the Edit menu.

Router Manager saves the Router Log as a text document in the Preferences folder. You can open this text document using most word-processing application programs.

You can use the Router Log to obtain information about the router's operation or to verify possible problems with the router. For information about using the Router Log to verify problems, see the section "Internet Problems" later in this chapter.

Internet problems

This section describes the symptoms, causes, and solutions for some internet problems that you might encounter during router operation, either exclusively on local internets, or on both local internets and wide area internets.

Before following any of these troubleshooting scenarios, verify that the network's hardware, cabling, or connections are not the source of the problem. In some cases, network problems, errors in the router setup, or the presence on the internet of a router that does not support AppleTalk Phase 2 are all possible causes of a symptom.

For additional information about problems with wide area internets, see *Using the AppleTalk/IP Wide Area Extension* and *Using the AppleTalk/X.25 Wide Area Extension.*

△ **Important** If solving a problem requires that you modify a port configuration or other router setup information in the startup document, you must first stop the router. Use Router Manager to modify the router's startup document, then restart the router. △

One or more devices appear in the wrong zone in the Chooser on one or more computers on the network.

Causes	*Solutions*
In a local internet:	
After changing a zone name, the administrator restarted the router Macintosh without waiting the recommended delay period. Thus, the new zone name appears in the Chooser on only some computers on the network. The administrator changed a zone name on the internet while a router was disconnected from the network, then reconnected the router.	Stop all routers connected to the network with the new zone name for at least ten minutes—allowing the routers to clear the obsolete zone information from their routing tables. Then restart all of the routers and they will update their routing tables with the new zone name automatically. See "Stopping the Router" in Chapter 8 and "Starting the Router" in Chapter 3.
On a router Macintosh that is concurrently being used as a file server or print server, the administrator selected the wrong AppleTalk connection as the user port or selected the wrong zone, using the Network control panel.	Stop the router, then change the user port or the zone, as necessary. See "Designating an AppleTalk Connection as the User Port" in Chapter 2 or "Changing the Router's Zone" in Chapter 8.

Devices that should be in the same zone are not.

Causes	*Solutions*
In a local internet:	
When configuring ports on a router, the administrator specified one or more zone names incorrectly.	For each network affected by this problem, identify any incorrect zone names in the zone list and specify zone names that are identical to those on the seed router. See "Renaming a Zone in the Zone List" in Chapter 4.
One or more devices on the network are in the wrong zone, because the user or administrator selected the wrong zone name in the Network control panel.	On each device affected by this problem, select the proper zone name in the Network control panel. See "Changing the Router's Zone" in Chapter 8.

A device does not seem to be functioning or the device performing a particular function is not the device that the user selected.

Causes	*Solutions*
In a local internet:	
Duplicate device names exist in a zone, because one or more of the devices having the same name were named before being connected to the network, or zones containing devices having the same name were merged. AppleTalk protocols detect duplicate devices names only at startup.	In zones affected by this problem, check the device list for devices having the same name that are of the type experiencing problems. Rename all but one of the devices having the same name. Restart all devices of the type experiencing problems. Device-name conflicts are resolved automatically at device startup, generally by suffixing each duplicate name with a number.

A hidden device appears in the Chooser on one or more computers on the network from which it is hidden.

Causes	*Solutions*
In a local internet:	
A redundant path to the device exists.	Hide the device when configuring the port through which a redundant path to the device exists. See "Hiding Devices on an Internet" in Chapter 4. Change the network topology to eliminate the redundant path to the device.
The device name was specified incorrectly.	Determine whether an incorrect device name is listed in the Hide Devices dialog box. Check for extra spaces or nonprinting characters in the name. Remove the incorrect device name, then add the correct device name to the list. See "Removing a Device From a List of Hidden Devices" in Chapter 8 and "Hiding Devices on an Internet" in Chapter 4.

The wrong option—either "no devices" or "all devices except those listed"—is selected in the Hide pop-up menu in the Hide Devices dialog box.	Select the appropriate option in the Hide pop-up menu. See "Hiding Devices on an Internet" in Chapter 4.
The device is hidden from the wrong port.	Select the correct port in the "from" pop-up menu. See "Hiding Devices on an Internet" in Chapter 4.

A device name does not appear in the Chooser on one or more computers on the network.

Causes	*Solutions*
In a local internet:	
A router on the internet is hiding the device.	Determine whether any router on the path from the device to the computer that cannot access the device is hiding the device. Remove the device from the list of hidden devices in that router's port configuration. See "Removing a Device From a List of Hidden Devices" in Chapter 8.
The routing distance to the missing network exceeds 15 hops.	Change the placement of routers in the network, making all paths between networks shorter than 15 hops. ***In a wide area internet:*** If a tunnel or half-routing link connects the networks, network-number remapping is active, and no loops exist on the internet, configure the tunneling ports to allow a routing distance that is greater than 15 hops. See "Allowing Routing Distances Greater Than 15 Hops" in Chapter 7. On a tunneling port, if "Increase routing distance by" is selected in the Options dialog box, either deselect it or decrease the number of hops. See "Increasing the Routing Distance Through a Port" in Chapter 7.

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In the seed routers' setup, two or more networks have the same network number or overlapping network ranges, causing only the zones or devices in the network found first during the Chooser's zone or device search—usually that having the shortest routing distance—to be displayed. This also occurs when network-number remapping is active and the network range for a local network overlaps the remapping range.	Assign a different network number or range to the network for which zones and devices do not appear in the Chooser. See "Changing a Network Number or Range" in Chapter 8. ***In a wide area internet:*** Specify a remapping range that does not conflict with an existing network number or range. See "Remapping Remote Network Numbers" in Chapter 7. If a tunnel or half-routing link connects the networks having conflicting numbers or ranges, activate network-number remapping. See "Remapping Remote Network Numbers" in Chapter 7.
In a wide area internet: Network hiding is active on a tunneling port and the computer on which the device does not appear in the Chooser is on a network that is hidden from the network on which the device resides.	Remove the network on which the computer resides from the list of hidden networks in the port configuration for that router. See "Removing a Network From a List of Hidden Networks" in Chapter 8. Move the device on which the Chooser is running to a network that is not hidden.
Network-number remapping is active on a tunneling port and the Router Log indicates that the router failed to remap all of the network numbers, because they did not fit into the remapping range specified.	Specify a larger remapping range. See "Remapping Remote Network Numbers" in Chapter 7.
Hop-count weighting is active on a tunneling port and a device across the tunnel is more than 15 hops away from a computer on the network connected to that port. Thus, that device does not appear in the Chooser on the computer across the tunnel.	Deactivate hop-count weighting on that port. See "Increasing the Routing Distance Through a Port" in Chapter 7.

One or more zones or networks do not appear in the Network Information window in Router Manager.

Causes	*Solutions*
In a local internet:	
Either the port to which a missing network is directly connected is inactive or a port on a router in the path to a missing network is inactive.	Determine whether a port is inactive on a router in the path from the network or networks to the router on which the networks do not appear in the Network Information window. Activate the port. See "Activating and Deactivating Ports" in Chapter 8.
The number of routing table entries exceeds the maximum specified. Thus, the routing table does not contain a complete list of networks.	Check the Router Log to verify the problem. Stop the router. In the Set Startup dialog box, increase the number of routing table entries. Restart the router Macintosh and start the router. See "Specifying the Routing Table's Maximum Size" in Chapter 3. Combine two or more networks into one. Use a bridge to combine separate networks into a larger network, having a single network number or range.
The number of zones defined in the internet exceeds the maximum number of zone table entries specified. Thus, the zone table does not contain a complete list of zones.	Check the Router Log to verify the problem. Stop the router. In the Set Startup dialog box, increase the number of zone table entries. Restart the router Macintosh, then start the router. See "Specifying the Zone Table's Maximum Size" in Chapter 3.
The port information for an AppleTalk port configured as a seed port conflicts with that for an existing seed port on another router, so the router deactivated the port having conflicting port information.	Check the Router Log to verify the problem. Specify the correct port information for the AppleTalk port with conflicting port information. See "Adding or Changing a Port Configuration" in Chapter 8. Check the Router Log to verify the problem. Make the AppleTalk port with conflicting port information a nonseed port. See "Configuring a LocalTalk Port" or "Configuring an EtherTalk or TokenTalk Port" in Chapter 4.

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There is no seed router on that network and the routers connected to that network have not yet obtained its network number.	On a router connected to that network, designate an AppleTalk port as the seed port, then specify a network number or range and a zone name or list for that port. See "Configuring a LocalTalk Port" or "Configuring an EtherTalk or TokenTalk Port" in Chapter 4.
The routing distance to the missing network exceeds 15 hops.	Change the placement of routers in the network, making all paths between networks shorter than 15 hops. ***In a wide area internet:*** If a tunnel or half-routing link connects the networks, network-number remapping is active, and no loops exist on the internet, configure the tunneling ports to allow a routing distance that is greater than 15 hops. See "Allowing Routing Distances Greater Than 15 Hops" in Chapter 7. On a tunneling port, if "Increase routing distance by" is selected in the Options dialog box, either deselect it or decrease the number of hops. See "Increasing the Routing Distance Through a Port" in Chapter 7.
In a wide area internet:	
The port information for a half-routing port contains an invalid password and the half-routing link could not be established.	Check the Router Log to verify the problem. Type the correct password. See "Entering Your Password to Open Router Manager" in Chapter 8.
The port information for a half-routing port contains an incorrect phone number and the half-routing link could not be established.	Check the Router Log to verify the problem. Type the correct phone number. See "Originating a Connection" and "Calling Back to Establish a Connection" in Chapter 5.
The router was unable to establish or maintain a half-routing link.	For information about troubleshooting half-routing links, see "Problems With Wide Area Internets" later in this chapter.

Network hiding is active on a tunneling port and the network is hidden.	Determine whether any router on the path from the network to the computer that cannot access the network is hiding the network. Remove the network from the list of hidden networks in that router's port configuration. See "Removing a Network From a List of Hidden Networks" in Chapter 8.
Network-number remapping is active on a tunneling port, and the router detected a loop on the internet and deactivated that port. However, the routing distance to the network over the redundant path exceeds the maximum of 15 hops.	Check the Router Log to verify the problem. Change the network topology to eliminate all loops. Turn off network-number remapping in the Options dialog box. See "Remapping Remote Network Numbers" in Chapter 7.

Problems with wide area internets

This section describes problems that are encountered only on wide area internets. For additional information about problems with wide area internets, see *Using the AppleTalk/IP Wide Area Extension* and *Using the AppleTalk/X.25 Wide Area Extension*.

In the Network Information window in Router Manager, the forwarding port indicated for a network should be a half-routing or tunneling port, but is not.

Causes	*Solutions*
Network-number remapping is active on a tunneling port, and the router detected a loop on the internet and deactivated that port.	Check the Router Log to verify the problem. Change the network topology to eliminate all loops. Turn off network-number remapping in the Options dialog box. See "Remapping Remote Network Numbers" in Chapter 7.

None of the zones or devices on networks across a tunnel appear in the Chooser on computers on networks connected to an exterior router attempting to communicate through that tunnel.

Causes	*Solutions*
Network hiding is active on a tunneling port and the networks on which the zones and devices reside are hidden.	Determine whether any router on the path from the zones and devices to the computer that cannot access the zones and devices is hiding the networks on which the zones and devices reside. Remove those networks from the list of hidden networks in that router's port configuration. See "Removing a Network From a List of Hidden Networks" in Chapter 8.
Network hiding is active on a tunneling port and the computer that cannot access the zones and devices is on a network that is hidden from the networks on which the zones and devices reside.	Remove the network on which the computer resides from the list of hidden networks in the port configuration for that router. See "Removing a Network From a List of Hidden Networks" in Chapter 8. Move the device on which the Chooser is running to a network that is not hidden.
The networks on which the zones and devices reside are more than 15 hops away from the computer on which the zones and devices do not appear in the Chooser.	If a tunnel or half-routing link connects the networks, and no loops exist on the internet, configure the tunneling ports to allow a routing distance that is greater than 15 hops. See "Allowing Routing Distances Greater Than 15 Hops" in Chapter 7. On a tunneling port, if "Increase routing distance by" is selected in the Options dialog box, deselect it. See "Increasing the Routing Distance Through a Port" in Chapter 7.
Network-number remapping is active on a tunneling port, and the router detected a loop on the internet and deactivated that port. However, the routing distance to the network over the redundant path exceeds the maximum of 15 hops.	Check the Router Log to verify the problem. Change the network topology to eliminate all loops. Turn off network-number remapping in the Options dialog box. See "Remapping Remote Network Numbers" in Chapter 7.
Network-number remapping is active on a tunneling port, the user port is not a seed port, and no seed router is present on the network connected to the user port	Configure a router on that network as a seed router. Configure the user port as a seed port.

None of the zones or devices on a network across a half-routing link appear in the Chooser on computers on networks connected to the router that is attempting to establish that half-routing link.

Causes	*Solutions*
The administrator typed a valid password in the Port Info window for the half-routing port on the router originating or answering the call.	Type the correct password in the Password and Reenter Password text boxes. See "Originating a Connection" and "Answering to Establish a Connection" in Chapter 5.
The administrator selected the call mode and typed an incorrect phone number in the Port Info window for the half-routing port.	Type the correct phone number in the Phone Number text box in the Port Info window for the half-routing port on which the call mode is selected. See "Originating a Connection" in Chapter 5.
With the answer-and-call-back mode selected, the phone number called back is not that of the router originating the connection.	Type the correct phone number in the Phone Number text box in the Port Info window for the half-routing port on which the answer-and-call-back mode is selected. See "Calling Back to Establish a Connection" in Chapter 5.
The phone line was noisy and the modem could not maintain the connection.	Consult the user's guide for your modem to determine whether this has occurred. If the problem persists, contact the modem manufacturer or the phone company.
The connection was broken and the modem was unable to reestablish the connection.	Reset the modems by turning them off, then on again. Reset the half-routing port by deactivating, then reactivating the port.
The modem configurations are incompatible.	Determine whether the modems are using the correct modem scripts by checking the connection selected in the Port Info window for each half-routing port. If not, select the appropriate connection. Consult the user's guides for the modems to determine whether they are configured properly and reconfigure them, as necessary.

Zones or devices on a network across a half-routing link appear intermittently in the Chooser on computers on the network connected to the router that established the half-routing link.

Causes	*Solutions*
The amount of network traffic is excessive for a slow half-routing link.	Check the Port Statistics window to determine whether the packet buffer is overflowing. If so, use a faster network system—such as bridged Ethernet—or a tunnel instead of the half-routing link. See "Monitoring Network Errors" in Chapter 9. Connect a modem with a faster data transmission rate to the router. Check the Port Statistics window to determine whether the packet buffer is overflowing. If so, provide a redundant path to the parts of the internet connected by the half-routing link. See "Monitoring Network Errors" in Chapter 9. Provide a redundant path, and use a faster network system or a tunnel to connect the parts of the internet connected by the half-routing link.
The phone line is noisy and the modem reduced its transmission rate to 2400 baud.	Consult the user's guide for your modem to determine whether this has occurred. If the problem persists, contact the modem manufacturer or the phone company.

Zones and devices on a hidden network appear in the Chooser on one or more computers on the network from which it is hidden.

Causes	*Solutions*
A redundant path to the network exists.	Hide the network on the port through which a redundant path to the network exists. See "Hiding Networks in an Internet" in Chapter 7. Change the network topology to eliminate the redundant path to the device.
The administrator specified the starting number of the network range incorrectly.	Determine whether a network number listed in the Options dialog box as the starting number of a network range is incorrect. Remove the incorrect network number, then add the correct network number to the list. See "Removing a Network From a List of Hidden Networks" in Chapter 8 and "Hiding Networks in an Internet" in Chapter 7.
The administrator selected the wrong option—"all networks except those listed"—in the Hide pop-up menu in the Options dialog box.	Select an appropriate option in the Hide pop-up menu. See "Hiding Networks in an Internet" in Chapter 7.

A zone name associated with a network that is no longer accessible appears in the Chooser on one or more computers on the network.

Causes	*Solutions*
On a half-routing or tunneling port, if a network that goes down is clustered and any other networks in the cluster remain on the internet, its zone names still appear in zone lists.	When you can interrupt network services, deactivate the port connected to the network, wait at least ten minutes, then reactivate the port to force reclustering. See "Activating and Deactivating Ports" in Chapter 8. Disconnect the other networks in the cluster.

A tunneling port is not activated when starting the router.

Causes	*Solutions*
The administrator is using a startup document in which the tunneling port is configured as inactive.	With the router running, click the Active button in the Port Info window for the tunneling port, then click Define to activate the port temporarily. See "Activating and Deactivating Ports" in Chapter 8. When the router is not running, click the Active button in the Port Info window for the tunneling port and click Define, then save the setup document with the tunneling port configured as active. See "Activating and Deactivating Ports" in Chapter 8.
Network-number remapping is active on a tunneling port, and the router detected a loop on the internet and deactivated that port.	Check the Router Log to verify the problem. Change the network topology to eliminate all loops. Turn off network-number remapping in the Options dialog box. See "Remapping Remote Network Numbers" in Chapter 7.

Once the primary path to a network again becomes accessible, the router continues sending some packets over a backup path.

Causes	*Solutions*
The network could not detect the reactivation of the primary path and the backup path is the shortest path to the network.	To use the primary path exclusively, deactivate the port that is functioning as the backup path, wait at least ten minutes, then reactivate the port. Stop the router on which a port is designated as a backup path for at least ten minutes, allowing the router to reestablish its primary path to the network. Then restart the router. See "Stopping the Router" in Chapter 8 and "Starting the Router" in Chapter 3.

The routing tables of the routers on the internet contain network numbers for unknown networks at various distances, many of which have the same zone names.

Causes	*Solutions*
Network-number remapping and clustering are active on a tunneling port, and the router failed to detect a loop on the internet.	Check the network topology to determine whether a loop exists across a tunneling port on which network-number remapping is active. If so, deactivate the port. See "Activating and Deactivating Ports" in Chapter 8.

Problems with the Apple Internet Router

This section describes the symptoms, causes, and solutions for some problems that you might encounter with the Apple Internet Router. Before investigating possible problems with the router, verify that the network or the internet is not the source of the problem.

A problem may exist with the Apple Internet Router if none of the zones or devices on a network connected directly to the router appear in the zone lists or device lists in the Chooser on computers in other networks, or in the Network Information window in Router Manager on other routers in the internet.

Possible causes of problems with the router include

- a break in one of its network connections
- hardware malfunctions
- hardware constraints—such as insufficient memory installed in the router Macintosh
- errors in the installation of the router software
- errors in the router setup
- changes made to the router Macintosh while the router is running—such as the startup disk becoming full

△ **Important** Stop the Apple Internet Router before attempting to solve problems with the router. If a problem exists with the router Macintosh or a component of the network, also shut down the router Macintosh before troubleshooting the problem. Once you have determined the source of the problem and have corrected it, restart the router Macintosh, if necessary, then start the router. △

Delays of up to several minutes occur when starting up the router Macintosh.

Causes	*Solutions*
An Ethernet cable that is connected to an Ethernet port on the router Macintosh is not terminated properly. Both sides of a standard T-connector require an Ethernet cable terminator. *Note:* The Apple Ethernet Thin Coax Transceiver and Apple Ethernet cable are self-terminating. If you connect these products to this port, this problem cannot occur.	If no Ethernet cable is connected to the port and the media is thin coaxial cable, plug a T-connector into the port, then terminate both sides of the connector with Ethernet cable terminators. If a T-connector is already plugged into the port and an Ethernet cable is connected to one side of the T-connector, terminate the other side of the connector with an Ethernet cable terminator. Terminate Ethernet cables connected to a T-connector plugged into the port.
A terminator is installed on a self-terminating Ethernet Thin Coax Transceiver. Therefore, the transceiver is doubly terminated.	Remove the terminator from the Apple Ethernet Thin Coax Transceiver.
If you have determined that the port and its cables are connected and terminated properly, a break may exist in the Ethernet cable.	Locate the defective cable and replace it.

None of the zones or devices on a part of the internet appear in the Chooser on computers on networks connected directly to the router.

Causes	*Solutions*
The administrator designated the wrong setup document as the startup document.	Designate the correct setup document as the startup document. See "Selecting a Startup Document" in Chapter 3.
An error occurred on a specific port, which was not activated when the router was started.	Check the Router Log to determine whether an error occurred on a specific port and take the appropriate corrective action.

The networks about which the router is propagating network information are not those listed in the router's port configurations.

Causes	*Solutions*
The administrator designated the wrong setup document as the startup document.	Designate the correct setup document as the startup document. See "Selecting a Startup Document" in Chapter 3.

You cannot read the information in the Network Information window in Router Manager because it redraws too frequently.

Causes	*Solutions*
The Network Information window redraws whenever the information changes.	Click Pause to freeze the display temporarily. Then, click Resume and the information displayed will reflect all changes that have occurred in the interim.

The Port Statistics window indicates that many packets have overflowed their buffer or that many data link errors have occurred, and the router's packet transmission rate is slow.

Causes	*Solutions*
The router is unable to process all of the packets that it receives.	Install the router software on a Macintosh with a faster microprocessor. If another network service is running on the router Macintosh, turn it off. If an application program other than Router Manager is open on the router Macintosh, quit it.

Router Manager error messages

Router Manager error messages report most problems with the Apple Internet Router, including setup errors. Most of these error messages are self-explanatory. This section provides information only about those errors requiring further explanation or having more than one possible error-recovery procedure. For detailed information about correcting errors in the router setup, see the section "Creating a Setup Document" in Chapter 3.

For information about error messages for the AppleTalk/IP Wide Area Extension, see *Using the AppleTalk/IP Wide Area Extension.* For information about error messages for the AppleTalk/X.25 Wide Area Extension, see *Using the AppleTalk/X.25 Wide Area Extension.*

If you encounter a problem that you cannot resolve through any other remedial action, reinstall the router software. See Chapter 2, "Installing the Basic Connectivity Package," for information about installing the router software. When you reinstall the router software, the startup options and administrator's password that you have specified are lost.

Messages displayed when opening Router Manager

This section provides additional information about some messages you might encounter when opening Router Manager.

Before opening Router Manager, you must use the Router Installer to install the Apple Internet Router software on the startup disk. Please install the router software, then try again.

You cannot simply copy Router Manager onto the startup disk by dragging its icon to the startup disk icon. Nor can you run Router Manager on the Installer disk. See Chapter 2, "Installing the Basic Connectivity Package," for information about installing the router software.

You cannot set up the router because there are no AppleTalk connection files in the Extensions folder. Please use the Router Installer to reinstall the router software, including these files, then try again.

AppleTalk connection files allow the router to communicate over various media. See Chapter 2, "Installing the Basic Connectivity Package," for information about installing the router software.

There is not enough memory available to start Router Manager. Please increase the memory allocation for Router Manager in its Info window, then try again.

To increase the amount of memory that Router Manager can use, select its icon in the Finder, then choose Get Info from the File menu. When the Router Manager Info window appears, increase its memory allocation in the "Current size" text box to a size that is greater than the suggested size. To be able to allocate a sufficient amount of memory for Router Manager, you may need to install more memory in the router Macintosh.

Alternatively, to make enough memory available to start Router Manager, you can quit any other applications that are currently open. Running the Apple Internet Router requires a Macintosh computer with at least four megabytes of memory installed. To run other applications concurrently on the router Macintosh, you may need to install more memory in the router Macintosh.

Messages displayed in Router Manager when there is insufficient memory

If there is insufficient memory available for Router Manager to perform an operation, an error message appears.

There is not enough memory available to [perform this operation].

Many error messages take this form. Some of these error messages appear when you are creating a setup document, some only when the router is running, and others regardless of whether the router is running.

In most cases, you should try closing some windows to make more memory available for the operation. The Network Information window and the Router Log require the most memory. If the Network Information window or the Router Log is currently open, close it.

If closing some windows does not make a sufficient amount of memory available, increase the memory allocation for Router Manager. To increase the amount of memory that Router Manager can use, quit Router Manager, then select its icon in the Finder and choose Get Info from the File menu. When the Router Manager Info window appears, increase the memory allocation in the "Current size" text box to a size that is greater than the suggested size. Finally, restart Router Manager. Allocating a sufficient amount of memory for Router Manager may require that you install more memory in the router Macintosh.

Router Manager is running out of memory. Please close some windows.

This message may appear regardless of whether the router is running. If closing some windows—for example, the Network Information window or the Router Log—does not make a sufficient amount of memory available, increase the memory allocation for Router Manager, as described earlier in this section.

There is not enough memory available to add all of the zone names that you have selected to the zone list. Please remove other zone names from the list, then try again.

This message may appear when you are creating a setup document. If all of the zone names in the zone list must remain in the list, try closing some windows to make more memory available for the zone list. If closing some windows does not make a sufficient amount of memory available, increase the memory allocation for Router Manager, as described earlier in this section.

There is not enough memory available to display the complete Router Log. Router Manager can display only the most recent information in the Router Log.

This message may appear when the router is running. If you want to display the complete Router Log, try closing some windows to make more memory available for the Router Log. If closing some windows does not make a sufficient amount of memory available, increase the memory allocation for Router Manager, as described earlier in this section.

Messages displayed when the router is not running

This section provides additional information about some error messages Router Manager might display when the router is not running.

The router name "=" is not allowed. Please specify a different router name.

AppleTalk protocols allow the equal sign (=) to be used as a wildcard character in the names of network devices, signifying "all possible values." You cannot use the equal sign as a router name.

Messages displayed when creating a setup document

This section provides additional information about some messages Router Manager might display when you are creating a setup document while the router is not running.

This setup document includes port information for an AppleTalk connection that is not available on this Macintosh. Router Manager cannot display and the router cannot use this port information.

If you start the router using this setup document, the router will not activate the port for which no AppleTalk connection file is available in the Extensions folder. If you want the router to activate this port at router startup, you must first quit Router Manager, use the Router Installer to reinstall the router software, including the AppleTalk connection file, reopen Router Manager, then start the router. Chapter 2, "Installing the Basic Connectivity Package," explains how to install the router software.

If this message appears for one of the following reasons, take the action described:

- A network interface card has been moved to a different expansion slot. Reconfigure the port.
- A network interface card has been removed from the router Macintosh. Close the setup document without saving any changes that you have made to it, then replace the interface card.
- The setup document has become corrupted. Create a new setup document. For information about creating a setup document, see the section "Creating a Setup Document" in Chapter 3.
- The setup document was created on a different router Macintosh with different hardware and software installed. Save the setup document and Router Manager will clear the port information for that AppleTalk connection.

This port currently uses the [Access Method] access method. Changing the access method to [Access Method] deletes the existing port information. Are you sure you want to change the access method?

You can configure only one access method—either LocalTalk or DialUp—for the printer port and for the modem port. For more information about configuring AppleTalk ports, see Chapter 4, "Configuring an AppleTalk Port."

Another port defined in this setup document is already using the network number that you specified. Please specify a different network number.

Each network on the internet must have a unique network number. The network number might be within a network range configured on another port.

The zone name "*" is not allowed. Please specify a different zone name.

AppleTalk protocols allow the asterisk (*) to be used as a wildcard character, signifying "this zone"—that is, the zone in which the device specifying the zone name resides. You cannot use the asterisk as a zone name.

Router Manager was unable to obtain any zone names from the current AppleTalk connection.

No other routers are currently accessible on the network connected to the port designated as the current AppleTalk connection for the router Macintosh in the Network control panel. Check for network problems. For information about troubleshooting such problems, see the section "Network Problems" earlier in this chapter.

The two passwords that you typed do not match. Please type the passwords again.

You can use uppercase and lowercase letters to distinguish passwords. You must type your password *exactly* as you did the first time, including your use of uppercase and lowercase letters.

The device type "=" is not allowed. Please specify a different device type.

AppleTalk protocols allow the equal sign (=) to be used as a wildcard character in the names of network devices, signifying "all possible values." You cannot use the equal sign as the name of a device type.

The device name "=" is not allowed. Please specify a different device name.

AppleTalk protocols allow the equal sign (=) to be used as a wildcard character in the names of network devices, signifying "all possible values." You cannot use the equal sign as a device name.

Router Manager cannot save the setup document "Document Name" because you do not have the proper access privileges.

The version of the setup document that was last saved or the folder or disk on which you are trying to save the setup document may be locked. To verify that the setup document, folder, or disk is locked, select it in the Finder, then choose Get Info from the File menu. When the Info window appears, click the Locked checkbox to unlock the setup document, folder, or disk if it is locked.

Macintosh file sharing or AppleShare might be denying access to the folder or the disk containing the setup document. In the Finder, choose Sharing from the File menu. If necessary, change your access privileges in the dialog box that appears. Or, use AppleShare to change your access privileges to the folder or disk containing the setup document.

Messages displayed when starting the router

This section provides additional information about some messages you might encounter when starting the router.

◆ **Note** The Router Log provides additional information about some errors encountered when starting the router. This information may help you to determine the cause of the problem. For more information about the Router Log, see "Using the Router Log to Obtain Information About Router Operation" earlier in this chapter. ◆

The actual network address of this Macintosh is different from that specified for this computer's AppleTalk connection in the startup document. Starting the router will interrupt this computer's current network services. Are you sure you want to start the router?

If you start the router, it will change the network address of the Macintosh computer to that specified for the computer's AppleTalk connection in the startup document.

The router cannot start because it was unable to find the startup document. Please select a different startup document, then try again.

If the startup document has been deleted from the startup disk, copy your backup version of the setup document that was designated as the startup document to the startup disk. Then, you must reselect the startup document in the Set Startup dialog box.

The router cannot start because the port corresponding to this computer's current AppleTalk connection is undefined in the startup document. Please define that port or use the Network control panel to select an AppleTalk connection that corresponds to a defined port.

If you need to define the port that corresponds to the current AppleTalk connection for the router Macintosh, open the Network control panel to determine its AppleTalk connection.

The router was unable to start because an error occurred while installing an AppleTalk connection driver for a configured port.

Check the Router Log to obtain information about the cause of the problem. If this message appears for one of the following reasons, take the action described:

- A network interface card has been moved to a different expansion slot. Reconfigure the port.
- A network interface card has been removed from the router Macintosh. Replace the interface card or remove the port configuration for the corresponding AppleTalk connection from the setup document. For information about removing a port configuration, see the section "Removing a Port Configuration" in Chapter 8.
- There is a problem with the physical network. For example, an Ethernet cable may not be terminated properly. Identify the location of the problem and correct it.
- There is not enough memory to install the AppleTalk connection driver. To run the Apple Internet Router, you must install additional memory.

The router cannot start because it was unable to access AppleTalk network services.

AppleTalk network services may be inaccessible due to a network problem. For information about troubleshooting such problems, see the section "Network Problems" earlier in this chapter.

This message may also appear because all available node IDs on a network connected to the router are currently in use. You may need to expand the network range. See the section "Changing a Network Number or Range" in Chapter 8.

The router cannot start because the Macintosh does not have enough memory.

Running the Apple Internet Router requires a Macintosh computer with at least four megabytes of memory installed. To run other applications concurrently on the router Macintosh, you may need to install more memory in the router Macintosh.

The router cannot start because there is no seed router on the network connected to the [Port Description] port.

This message appears only if a nonseed router is starting for the first time, and there is no seed router on a network connected to one of its ports and that port is not a LocalTalk port. A nonseed router will start if there is no seed router on a network connected to one of its LocalTalk ports.

The router cannot start because the network number [###] that you specified for one of the router's ports is different from the network's actual number [###]. Please use Router Manager to specify the port's correct network number, then try again.

Obtain the correct network number for the port from another router on the network connected to the port. Alternatively, you can make the port a nonseed port.

The router cannot start because the network range [###] to [###] that you specified for one of the router's ports is different from the network's actual range [###] to [###]. Please use Router Manager to specify the port's correct network range, then try again.

Obtain the correct network range for the port from another router on the network connected to the port. Alternatively, you can make the port a nonseed port.

The router cannot start because "Zone Name," the zone name that you specified for one of the router's ports, is different from the network's actual zone name, "Zone Name." Please use Router Manager to specify the port's correct zone name, then try again.

Obtain the correct zone name for the port from another router on the network connected to the port. Alternatively, you can make the port a nonseed port.

The router cannot start because the zone name "Zone Name" in the zone list for the network range [###] to [###] is not in the network's actual zone list. Please use Router Manager to specify the correct zone name for that network range, then try again.

Obtain the correct zone name for the network range from another router on the network. Alternatively, you can make the port a nonseed port.

The router cannot start because the zone list you specified for the network range [###] to [###] does not contain the zone name "Zone Name," which is in the network's actual zone list. Please use Router Manager to specify the correct zone name for that network range, then try again.

Obtain the correct zone name for the network range from another router on the network. Alternatively, you can make the port a nonseed port.

The router cannot start because the zone list you specified for the network range [###] to [###] is different from the network's actual zone list. Please use Router Manager to specify the correct zone list for that network range, then try again.

Obtain the correct zone list for the network range from another router on the network. Alternatively, you can make the port a nonseed port.

The router cannot start because "Zone Name," the default zone that you selected for one of the router's ports, is different from the network's actual default zone, "Zone Name." Please use Router Manager to select the port's correct default zone, then try again.

You must select the same default zone for a network range on each seed router on the network. Obtain the correct default zone for the network range from another router on the network. Alternatively, you can make the port a nonseed port.

Messages displayed when the router is running

This section provides additional information about some error messages Router Manager might display when the router is running.

Router Manager cannot activate the port because conflicting network or zone information exists on another router.

While the port was inactive, conflicting network or zone information for the network connected to the port was specified on another router on that network. Obtain the correct network number, network range, zone name, or zone list for the port from the other router.

Router Manager cannot export data to the folder or disk selected because you do not have the proper access privileges.

The folder or the disk to which you are trying to export data may be locked. To verify that the folder or the disk is locked, select it in the Finder, then choose Get Info from the File menu. When the Info window appears, click the Locked checkbox to unlock the folder or the disk if it is locked.

Macintosh file sharing or AppleShare may be denying access to the folder or the disk to which you are trying to export data. In the Finder, choose Sharing from the File menu. If necessary, change your access privileges in the dialog box that appears. Or, use AppleShare to change your access privileges to the folder or the disk.

Appendix A: Planning Your AppleTalk Internet

This appendix provides guidelines for planning your AppleTalk internet. Topics discussed include:

- evaluating your need for interconnected networks
- planning your internet's physical layout—including information about router placement, backbone networks, redundant paths, and optimizing performance
- choosing a network-numbering scheme
- specifying network ranges
- dividing your internet into zones

When should you create an internet?

When planning a new network or expanding an existing network, you can use an Apple Internet Router to create an *internet* consisting of two or more interconnected networks.

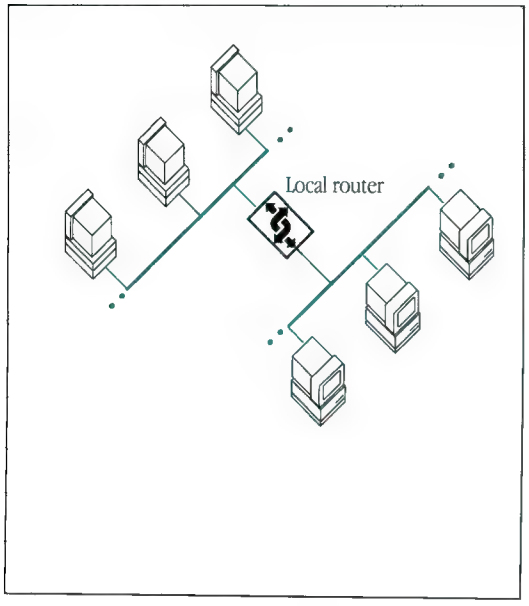
The router maintains a logical map of networks in an internet and can route data onto the most efficient path to a network. The most efficient path available between any two networks may be either the path having the shortest routing distance in hops—or fewest intervening routers—or the path with the highest data transmission rate. Figure A-1 shows how you can use a router to connect local networks, connect remote networks, and connect networks to a backbone.

The router allows you to

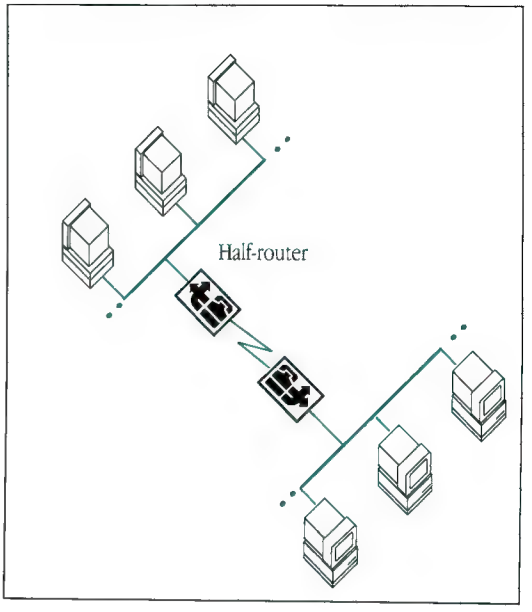
- *connect two or more local networks* You can interconnect individual networks that are in close proximity to one another, allowing workgroups in different departments of an organization to communicate and share network services.
- *extend an existing network* If a network already includes the maximum number of devices or has the maximum cable length allowed, you can use a router to extend the network. The number of devices on an internet can exceed the 32-device limit for a single LocalTalk network.
- *connect networks of different types* You can connect different types of networks, such as LocalTalk, Ethernet, and Token Ring. Different network types use different *access methods*—including different transmission media, built-in ports or ports on network interface cards, and different AppleTalk connection files.
- *connect two remote networks* You can connect two remote networks or internets through a *half-routing link,* consisting of two half-routers connected to modems communicating over a standard telephone line or a leased line.
- *connect networks to a backbone network* You can connect either local or remote networks to a backbone network to minimize the routing distances between the networks and improve performance. Any two networks connected directly to a backbone are just two hops away from one another. For more information about backbone networks, see the section "Creating a Backbone Network" later in this chapter.
- *connect networks through foreign network systems* You can connect two or more AppleTalk networks or internets through a network system that uses a different protocol family, such as TCP/IP.

*A **router** maintains a logical map of the networks in an internet, in which each network has a unique address.*

Local networks



Remote networks



Networks connected to a backbone

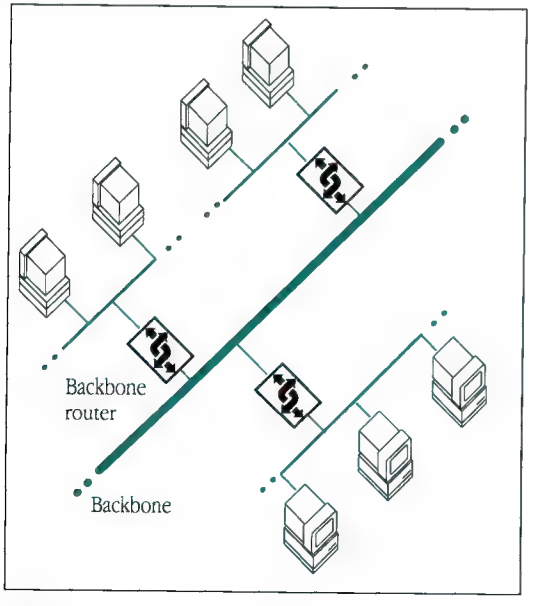


Figure A-1 Using a router

- *isolate local traffic on different parts of an internet* You can improve an internet's performance by creating separate networks for workgroups that generate high levels of network traffic.
- *divide a network into zones* By dividing a network into logical groupings of devices, you can
  - facilitate user's access to shared network services, such as printers and servers
  - accommodate workgroup requirements for network services, minimizing the amount of network traffic between zones and improving network performance

Planning the physical layout of your internet

When designing your internet, plan for growth. Each network in an internet should initially consist of fewer than the maximum number of devices. It's easier to add a device to an existing network than to create an additional network. However, if the level of traffic on a network creates bottlenecks and degrades performance, you can use a router to divide that network into two networks.

Placing routers in an internet

The Apple Internet Router can connect AppleTalk networks that differ in type, topology, and size. You can place a router at any location within a network. Figure A-2 shows some possible router locations.

To determine the optimal location for a router in your internet, follow these guidelines:

- To connect two existing networks, place a router between them.
- To extend an existing network, use a router to subdivide the network into two or more networks.
- To connect two AppleTalk networks of different types—for example, LocalTalk and EtherTalk—place a router between them.

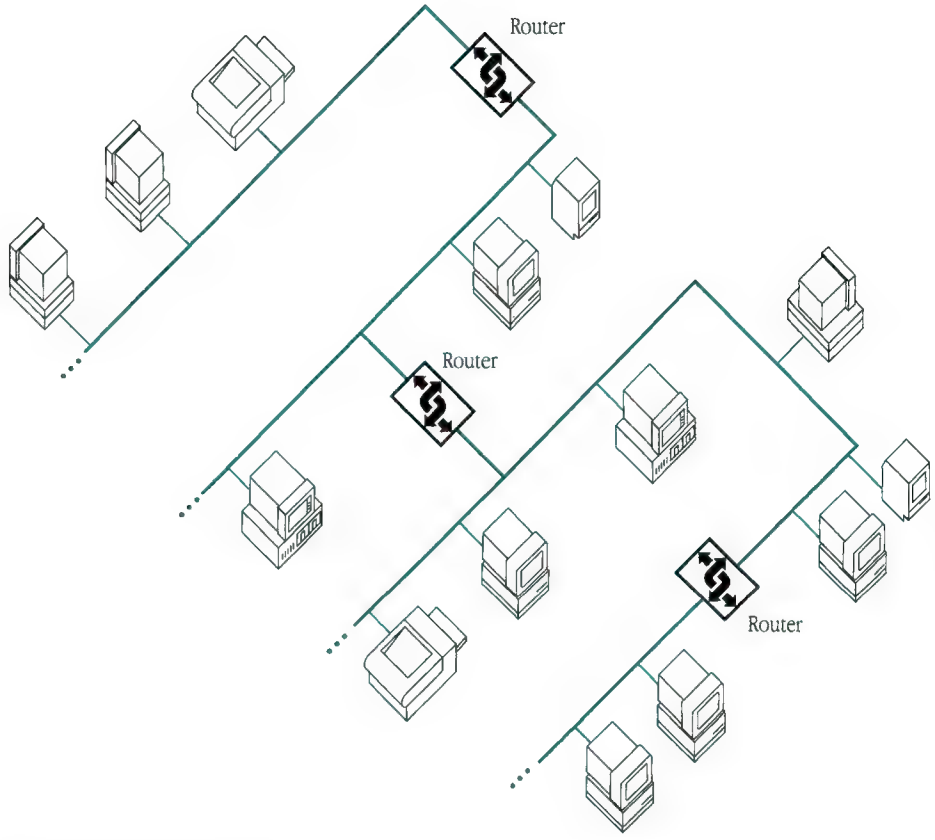


Figure A-2 Router locations

- To connect two remote networks or internets through a half-routing link, connect a router on each network or internet to a modem and a point-to-point link.
- To connect a network to a backbone network, place a router between them.
- To connect two or more AppleTalk networks or internets through a foreign network system, connect a router on each network or internet to the foreign network system.
- To isolate a part of an internet on which there is a high level of traffic, use a router to create separate networks.
- Create an internet layout that minimizes the routing distances between all connected networks.
- On a local internet, create redundant paths between networks to improve network performance and reliability.

- To avoid traffic congestion, balance the levels of network activity on different parts of the internet.
- To prevent unnecessary cross-network traffic, avoid placing a router between users and any devices providing network services to which they require frequent access, unless the devices are connected to a backbone network. For more information about backbone networks, see the next section, "Creating a Backbone Network."

By following these guidelines for router placement, you can improve performance on your internet.

Creating a backbone network

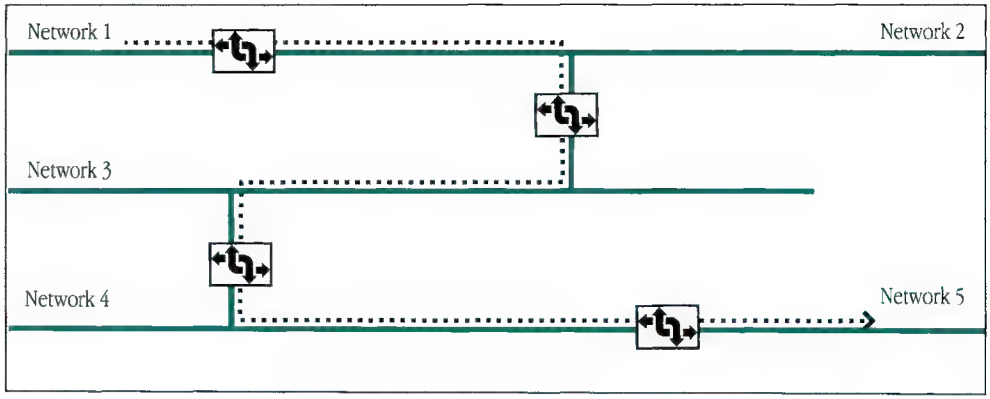
By connecting individual networks in an internet to a backbone network, you can create a highly efficient network layout. A *backbone network* is typically a high-speed network that connects other, lower-speed networks. A backbone network alleviates the problem of cross-network traffic congestion by providing each network in the internet with a more direct route to every other network in the internet. The routing distance between any two networks connected by routers directly to a backbone network is just two hops.

Figure A-3 shows an internet without a backbone network and another internet that includes a backbone network. In the internet with no backbone, four routers connect five networks serially. A packet sent across the internet—from Network 1 to Network 5—would have to travel four hops and contend with network traffic on the three intervening networks. The same packet would have to travel only two hops on the internet with a backbone.

A backbone network is particularly advantageous when you must connect many networks or when the networks being connected are not physically contiguous with one another. To improve access to a device that provides a network service—such as a file server—you can connect the device directly to the backbone.

On an internet built around a backbone network, if a break occurs on any network other than the backbone network, access to network services remains uninterrupted on all other networks connected to the backbone—with the exception of network services that reside on the network on which the break occurred.

An internet without a backbone



An internet with a backbone

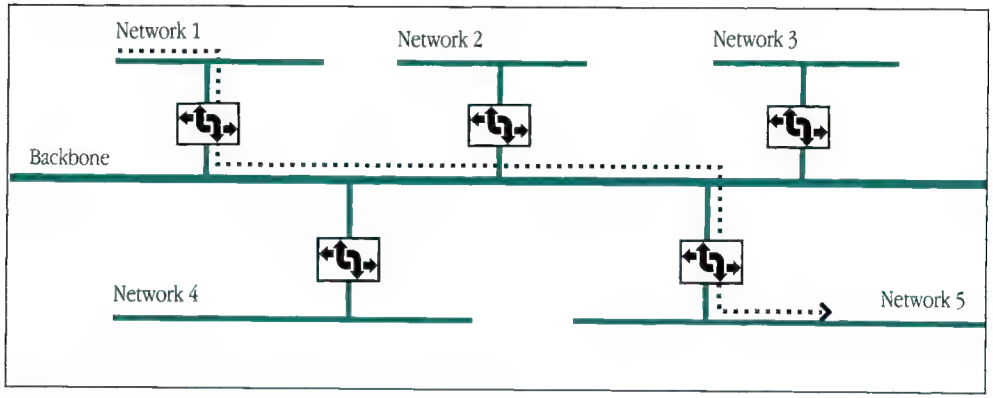


Figure A-3 An internet versus a backbone network

Choosing a type of backbone network

You can use any type of AppleTalk network as a backbone network. While a backbone network that uses the same type of media as the other networks in an internet can minimize routing distances between networks connected directly to it, you can optimize the internet's performance by using a high-speed network—such as an Ethernet or Token Ring network—as a backbone. You can also use a tunnel built on a foreign network system as a backbone.

Connecting networks having different transmission rates

When connecting networks of different types, which have different transmission rates, use high-speed networks where levels of network activity are high. Avoid placing a lower-speed network between two high-speed networks. Figure A-4 shows an inappropriate network layout and two efficient network layouts.

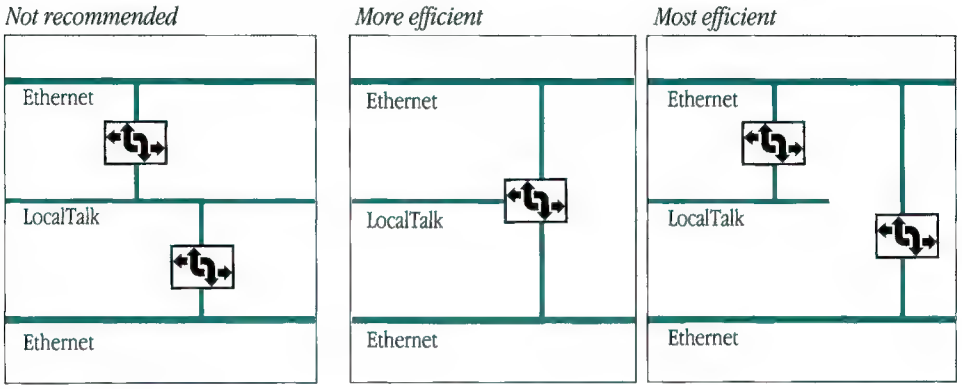


Figure A-4 Network layouts

Where redundant paths exist, the Apple Internet Router generally does not distinguish between networks having different transmission rates. It simply selects the most direct path to a network—that with the fewest hops. To ensure that the router will select a path through a network that has a high transmission rate, you can

- create an internet layout in which the path through a high-speed network has a shorter routing distance
- eliminate any redundant path though a lower-speed network
- increase the routing distance through a half-routing or tunneling port to which a lower-speed network is connected
- designate a half-routing or tunneling port to which a slow point-to-point link or a lower-speed network is connected as a backup path

For more information about redundant paths, see the next section, "Creating Redundant Paths." Also, see the section "Increasing the Routing Distance Through a Port" in Chapter 7.

Creating redundant paths

By creating redundant paths to each network in an internet, you can ensure that a network will not become inaccessible to the rest of the internet should a break occur on one path. If there is more than one path to a network, the router can select the most efficient path available—either the shortest path or that having the highest transmission rate—improving network performance. Figure A-5 shows the addition of a router to an internet to create a redundant path between two networks. This layout improves the reliability of the internet and reduces the routing distances between some networks.

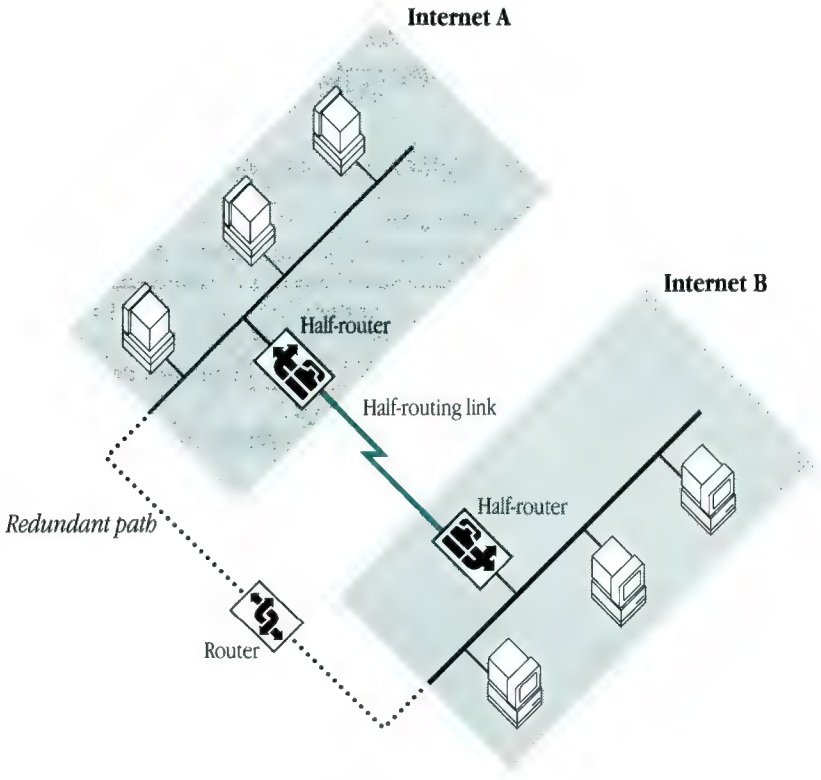


Figure A-5 Creating redundant paths

△ **Important** You must eliminate any redundant paths, or routing loops, that exist across a half-routing link or tunnel before activating network-number remapping on the corresponding half-routing or tunneling port. If the router detects a loop, it will deactivate any tunneling port on which network-number remapping is active. For more information about network-number remapping, see the section "Resolving Numbering Conflicts by Remapping Remote Network Numbers" in Chapter 7. △

If redundant paths having the same routing distance exist between two networks, troubleshooting may be more difficult. You may have difficulty discerning the path selected by the router.

Laying out your internet for optimal performance

Router Manager provides information about network-activity levels and error statistics. To maintain an optimal level of performance on your internet, you should evaluate the levels of network activity on different parts of the internet and endeavor to balance the use of network services.

Evaluating network activity

Devices communicating on an internet generate network traffic. Two types of *traffic* occur on an internet:

- traffic generated by networking devices—for example, when a router sends updated routing information to the other routers on an internet
- traffic generated when users access network services—for example, when a computer accesses a printer, a file server, or another computer

An internet's size and layout, the different types of network services available on the internet, and the frequency with which users access network services determine the volume of network traffic, or level of activity, on the internet.

When planning your internet, analyze the expected levels of usage for planned network services and estimate the resulting level of network activity. Also, evaluate what workgroups

are likely to generate high levels of network traffic. Then, determine what router placement would balance traffic on the internet. If your internet is built around a backbone network, connect devices providing shared network services directly to the backbone. Avoid placing a router between users and devices that are providing network services frequently accessed by them, unless those devices are connected directly to a backbone. Placing a router between users and such a device would cause unnecessary traffic through the router and on any intervening networks.

Use Router Manager to monitor the current level of activity on the internet. The Router Statistics window shows the number of packets routed and the level of network activity, indicating the current volume of traffic on the internet. The Port Statistics window shows the number of packets routed through each port on the router. The sections "Monitoring Network Activity and Reliability Over Time" and "Monitoring Port Statistics" in Chapter 9 describe the information provided in the Router Statistics and Port Statistics windows.

An excessive volume of traffic on one part of the internet can create bottlenecks, degrade network performance, and cause delays in the delivery of network services to users. If the services available on a given network generate an excessive amount of traffic, use a router to divide the network into two smaller, interconnected networks.

Evaluating network error statistics

Use Router Manager to monitor error statistics for the router. The Router Statistics window shows the current levels of network reliability and network errors. The Port Statistics window shows error statistics for each port on the router. For information about these error statistics, see the sections "Monitoring Network Activity and Reliability Over Time" and "Monitoring Port Statistics" in Chapter 9.

Choosing a network-numbering scheme

When specifying network numbers, it's advisable to use a consistent numbering scheme. For example, the digits of a network number might constitute a code that indicates the network's physical location or department, as shown in Figure A-6.

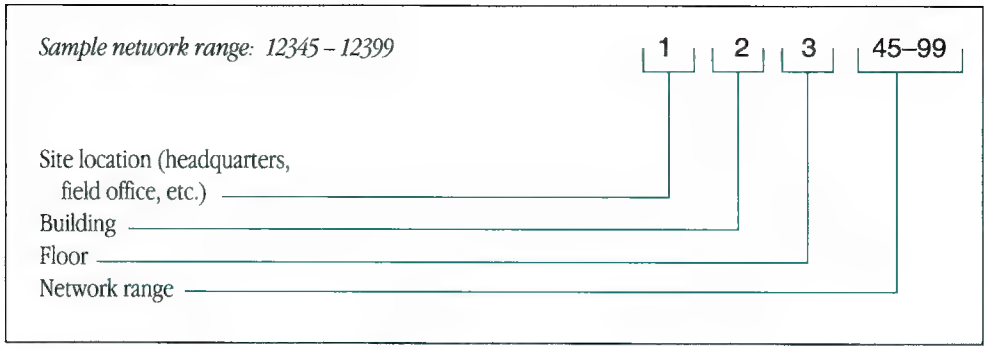


Figure A-6 A network-numbering scheme

This kind of network-numbering scheme

- allows you to reserve network numbers for future networks, facilitating the specification of network numbers when you add networks to your internet
- provides a meaningful identifier for each network on the internet, allowing you to associate the network numbers in a routing table with the physical locations of the corresponding networks
- allows you to connect existing networks without creating network-numbering conflicts

Record the network numbers and ranges for your internet in a logbook, in a spreadsheet, or on a network map.

Specifying network ranges

Each network number in a network range allows you to connect an additional 253 devices. Thus, the size of the network range that you specify for a network determines the maximum number of devices on that network. For example, a network having the range 1–10 can include up to 2530 devices (10 x 253). If you never expect an Ethernet or Token Ring network to expand beyond 253 devices, you can assign that network a network range consisting of a single network number—for example, 100–100.

A network range must be of a sufficient size to allow for future network growth. For example, the network range 1–2 allows expansion up to 506 devices (2 × 253). However,

if a network already consisted of 500 devices, the network range 1–2 would allow you to connect only 6 additional devices to that network. Once the network exceeded this number of devices, you would need to specify a larger range for the network. The *seed routers* on an internet send a network's identifying information to all other routers connected directly to the network. To increase the size of a network range, you would have to stop *all* of the routers on the network, disrupting network services.

You should generally specify a network range that could accommodate at least twice the number of devices currently on your internet. An AppleTalk internet can support up to 65,279 networks, or over 16 million devices (65,279 × 253). Thus, you can specify a large range for each network on the internet and still have enough network numbers available for even a very large internet. To make possible the subsequent expansion of existing network ranges, specify network ranges that are separated from one another by a sequence of network numbers. For example, if you specify the network range 100–110 for one network, specify a network range that starts with the network number 120 for the next network, rather than one that starts with the network number 111.

Dividing an internet into zones

Zones are logical groupings of devices on an AppleTalk internet. Each device on an internet resides in a zone. You can assign any number of devices to a zone and can change groupings of devices into zones without changing the physical network connections between those devices. Zones have no physical boundaries.

When setting up a router, you can create zones by associating one or more zone names with each network connected to the router. You can associate only one zone name with a LocalTalk network. All devices connected to a LocalTalk network are in the same zone. You can associate a zone list consisting of one or more zone names with an Ethernet or Token Ring network. Therefore, you can assign devices on the same Ethernet or Token Ring network to different zones. You can also specify a default zone for the devices on each network. The zone names associated with the networks in an internet appear in zone lists in Router Manager, the Chooser, and other networking applications. For more information about creating zones, see the sections "Defining AppleTalk Zones for a Network" in Chapter 4.

Balancing network services on the internet

Zones facilitate access to shared network services, such as printers and file servers. If an internet with many shared network services were not divided into zones, finding a device in the Chooser's device list would be very time consuming and inconvenient. When accessing a device in the Chooser on an internet that is divided into zones, the user must first select the zone in which the device resides. The user sees only the devices in the zone that is currently selected, rather than all of the devices on the internet. Thus, the user can access devices efficiently.

Facilitating departmental work

You can create zones for users belonging to specific departments or workgroups, and accommodate their special requirements for network services. Users at computers in a zone can most efficiently access shared network services provided by devices in the same zone. Determine what users or workgroups need to communicate or share network services, then assign the appropriate devices to one zone.

Computers or other devices assigned to a zone can reside on the same network or on different networks—even on networks at different physical locations—enabling users to access shared network services efficiently. However, assigning computers on different networks to the same zone may result in high levels of traffic on the internet. As shown in Figure A-7, a user at a computer in Zone B on the Token Ring network who is accessing a file server in Zone B on the LocalTalk network generates traffic on both the intervening Ethernet network and on the LocalTalk network.

Devices connected to different physical networks can be in the same zone.

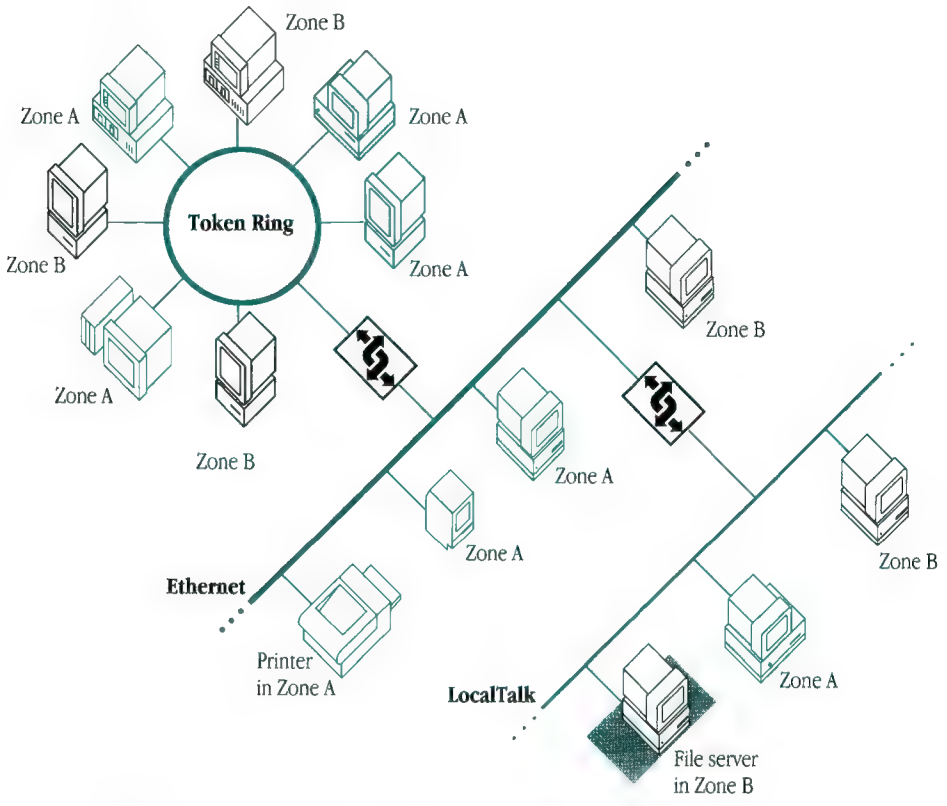


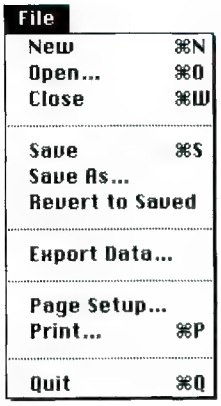
Figure A-7 An internet divided into zones

To isolate traffic on a network in a large internet, you can create a zone and assign only devices on that network to the zone. This minimizes cross-network traffic and improves network performance.

Appendix B: The Router Manager Program

You can use the Router Manager application program to set up the router, control and troubleshoot router operation, and monitor network performance. The sections that follow briefly describe the program's menus.

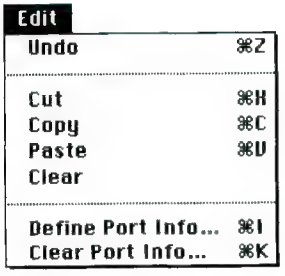
File menu

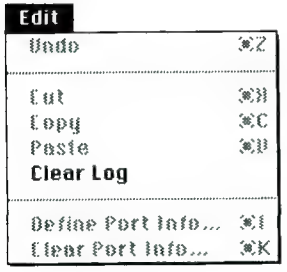


The commands in the File menu allow you to work with setup documents, and to export and print routing information. The File menu includes the standard commands New, Open, Close, Save, Save As, Revert to Saved, Page Setup, Print, and Quit. Refer to the manuals that came with your Macintosh computer for information about how to use these standard commands.

You can use the Export Data command to export the information in the Network Information window or the Port Statistics window to a text document that has a tab-delimited format, as described in the section "Exporting Information" in Chapter 9.

Edit menu



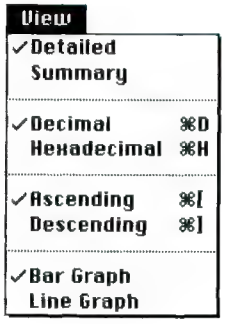


You can use the commands in the Edit menu to edit text, and to display, edit, and clear port information. The Edit menu includes the standard commands Undo, Cut, Copy, Paste, and Clear. For information about using these standard commands, refer to the manuals that came with your Macintosh computer.

When the Router Log is the active window, the Clear command changes to Clear Log, as shown in the figure at the left.

For information about using...	See the section...
The Clear Log command—to clear all entries from the Router Log	"Using the Router Log to Obtain Information About Router Operation" in Chapter 10
The Define Port Info command—to specify, edit, or display a port configuration	"Creating a Setup Document" in Chapter 3
The Clear Port Info command—to clear the information from a port configuration	"Removing a Port Configuration" in Chapter 8

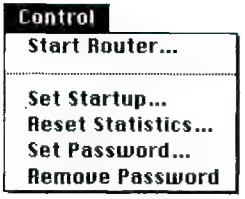
View menu



Using the commands in the View menu, you can control the display of information in setup windows, in the Network Information window, and in the Router Statistics window. A checkmark appears beside each option that is currently selected.

For information about using...	See the section...
The Detailed and Summary commands—to control the display of information in setup windows and in the Network Information window	"Customizing Your View of a Setup Window" in Chapter 8 "Monitoring Network Routing Information" in Chapter 9
The Decimal and Hexadecimal commands—to control the display of numeric information in setup windows and in the Network Information window	"Customizing Your View of a Setup Window" in Chapter 8 "Monitoring Network Routing Information" in Chapter 9
The Ascending and Descending commands—to control the order in which information in the Network Information window is sorted	"Starting the Routing Table" in Chapter 9
The Bar Graph and Line Graph commands—to control the graphical display of information in the Router Statistics window	"Monitoring Network Activity and Reliability Over Time" in Chapter 9

Control menu

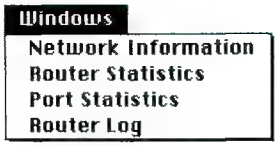


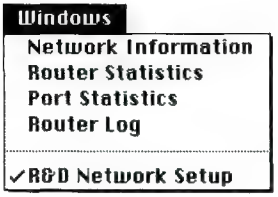
The commands in the Control menu allow you to start and stop the router, select a startup document and other startup options, reset router and port statistics, set an administrator's password for Router Manager, and remove password protection from Router Manager.

When the router is running, the Start Router command changes to Stop Router, as shown in the figures at the left.

For information about using...	See the section...
The Start Router and Stop Router commands—to start and stop the router	"Starting the Router" in Chapter 3 "Stopping the Router" in Chapter 8
The Set Startup command—to select startup options, including the startup document	"Configuring the Router for Startup" in Chapter 3
The Reset Statistics command—to reset router and port statistics	"Resetting Router and Port Statistics" in Chapter 9
The Set Password command—to set an administrator's password for Router Manager	"Specifying an Administrator's Password" in Chapter 3
The Remove Password command—to remove password protection from Router Manager	"Removing Password Protection" in Chapter 8

Windows menu





The Network Information, Router Statistics, Port Statistics, and Router Log commands in the Windows menu allow you to display the corresponding windows when the router is running.

When the router is not running, the Windows menu also contains the names of any setup documents that are currently open. When the router is running, the startup document appears in the Windows menu.

You can also use the Windows menu to make active any window that is currently open. A checkmark beside an item in the Windows menu indicates that the corresponding window is currently the active window.

For information about using...	See the section...
The Network Information window	"Monitoring Network Routing Information" in Chapter 9
The Router Statistics window	"Monitoring Network Activity and Reliability Over Time" in Chapter 9
The Port Statistics window	"Monitoring Port Statistics" in Chapter 9
The Router Log	"Using the Router Log to Obtain Information About Router Operation" in Chapter 10

Glossary

access method A method of encapsulating packets of data for transmission over a network of a specific type that is connected to one of the router's ports—for example, a LocalTalk, DialUp, EtherTalk, or TokenTalk access method. See also *router port.*

access privileges Permissions granted by the owner of a file, folder, or disk that allow another user or group of users to access or make changes to it. A user can set access privileges for file sharing in the Finder; a network administrator, in AppleShare.

address See *network address.*

administrator See *network administrator.*

administrator's password A string of characters that a network administrator must enter to open Router Manager. Compare *caller's password.*

Apple Ethernet Cable System A family of products from Apple Computer that provides connectivity to Ethernet networks, including self-terminating thin coaxial Ethernet cable, transceivers, and media adapters. See also *Ethernet.*

Apple Ethernet Thin Coax Transceiver A device with a built-in terminator that connects a computer or other device that has an Apple Ethernet port to an Ethernet network that uses thin coaxial cable. See also *transceiver.*

AppleShare file server A file server that consists of a Macintosh computer running AppleShare File Server software, and one or more high-capacity hard disks. See also *file server.*

AppleTalk A network system that consists of a family of protocols that allow communication over various types of networks, as well as network services and application programs. See also *network system* and *protocol.*

AppleTalk connection An AppleTalk network of a specific type that is both connected to and communicating with a device.

AppleTalk connection file The software that allows a Macintosh computer to communicate with a specific type of AppleTalk network. Also referred to as an *AppleTalk connection driver.* See also *AppleTalk connection* and *driver.*

AppleTalk/IP Wide Area Extension An Apple Internet Router extension that allows two AppleTalk networks or internets to communicate through a tunnel built on a TCP/IP network.

AppleTalk network A network on which devices use AppleTalk protocols to communicate.

AppleTalk Phase 2 The current version of the AppleTalk protocol family, which supports large internets. See also *internet.*

AppleTalk port A port that uses either a LocalTalk, EtherTalk, TokenTalk, or other access method to connect to a network of the corresponding type—for example, LocalTalk, Ethernet, or Token Ring.

AppleTalk/X.25 Wide Area Extension An Apple Internet Router extension that allows two or more remote AppleTalk networks or internets to communicate over a half-routing link using X.25 protocols.

asynchronous A type of data transmission that is used between computers and modems, in which each message is preceded by a start bit and followed by a stop bit, allowing the transmission of messages at irregular intervals.

backbone network Typically, a central high-speed network—such as an Ethernet or Token Ring network—that connects other, lower-speed networks.

background routing A software process that performs routing in the background, allowing the simultaneous use of the router Macintosh for other purposes while the router is running.

backup path A redundant path through a half-routing or tunneling port that the router uses only to exchange routing information. The router forwards AppleTalk data packets over a backup path only if the primary path to a specific network becomes unavailable. See also *redundant paths.* Compare *primary path.*

bits per second (bps) A unit of measurement for a data transmission rate characteristic of a modem.

broadcast To send data simultaneously to all devices on a network.

bps Acronym for *bits per second.*

buffer Memory reserved for the temporary storage of data whenever the rate at which a device or program receives data exceeds the rate at which it can process the data.

bus topology A type of network topology in which devices are connected serially, from one end of a length of cable to the other. All of the devices have equal access to the network and receive only those packets sent to their address. See also *topology.*

caller's password A string of characters that an administrator enters to allow a remote router to obtain access to the local internet. Compare *administrator's password.*

Chooser A program that allows you to activate and deactivate AppleTalk, and select network services. See also *network service.*

cluster (verb) To represent a range of remapped networ numbers as a single extended network consisting of multipl zones, requiring only one entry in a routing table. See also *routing table.*

cluster (noun) A single extended network, consisting of multiple remapped networks and zones, that requires only one entry in a routing table. See also *routing table.*

clustering On a half-routing or tunneling port on whic network-number remapping is enabled, the representatio by a router of a range of remapped network numbers as single, extended network, consisting of multiple zones, t minimize routing traffic and routing-information storage requirements. See also *network-number remapping.*

coaxial cable A type of media that consists of a centra conducting wire and a surrounding braided-mesh groun wire, separated by a layer of insulation, and an outer laye of shielding. It is appropriate for networks that have high transmission rates, span long distances, and are subject t high levels of electromagnetic interference. See also *media*

configuration See *port configuration.*

connection See *AppleTalk connection* and *network connection.*

CRC Acronym for *cyclic redundancy check.*

cross-network traffic The network activity generated on intervening networks when two devices communicat

cyclic redundancy check (CRC) An error-checking control technique that inserts a frame-check sequence based on the content of a frame at the end of that frame to verify that no transmission errors have occurred. A

frame is a unit of data transmitted by data-link layer protocols that allow communication with LocalTalk, Ethernet, Token Ring, or other networks.

data packet See *packet.*

data link error A network-system hardware error detected by the router on receiving or transmitting packets.

decimal A base ten numbering system.

dedicated router A router running on a computer on which no other network services reside and no other application programs are running. Compare *nondedicated router.*

default A preset value or setting that a computer or program uses, unless another value or setting is specified.

default zone The zone in which a device connected to a network appears until a user or the administrator selects a different zone for that device.

device A hardware unit—such as a Macintosh computer or a LaserWriter printer.

device driver See *driver.*

device hiding Configuring an AppleTalk port to provide device-level security by hiding specific devices or all devices on the network or internet connected to that port, from another port or all other ports on the router.

device list In Router Manager, the Chooser, or another program, a list of devices connected to a network.

device name An identifier specified for a computer, peripheral, or other device on a network.

device type A type of service on a network—for example, a type of computer or peripheral device.

dial-in link A half-routing link through a telephone line.

DialUp An access method for the printer or modem port that allows the port to function as a half-routing port. See also *access method.*

distance See *routing distance.*

driver System software that is generally installed in the Extensions folder, and allows a computer to control the operation of an expansion card or peripheral device—such as the LaserWriter driver.

Ethernet A widely used, high-speed network type that provides a transmission rate of 10 megabits per second, supports bus or star topologies, and uses various types of media.

Ethernet port A physical port to which an Ethernet network is connected. See also *port.*

EtherTalk An AppleTalk connection or access method that allows an Ethernet network to use AppleTalk protocols. See also *access method* and *AppleTalk connection.*

export To save the data in the Network Information window or Port Statistics window to a document with a tab-delimited format.

extension See *router extension.*

exterior router An AppleTalk router on which one or more ports are connected to an AppleTalk internet, and one or more ports are connected to either a foreign network system or a half-routing link.

file server A computing device with one or more high-capacity hard disks that allows users to store, retrieve, and share folders, documents, and programs over a network. See also *AppleShare file server.*

foreign network system A network system that uses a protocol family other than AppleTalk—for example, TCP/IP. See also *network system.*

forwarding port A port through which the router sends packets to their destination networks.

fully connected tunnel A tunnel on which all of the connected exterior routers can communicate with one another. Compare *partially connected tunnel.* See also *tunnel.*

half-router A router that is used to connect two remote AppleTalk networks or internets. See also *remote network* and *router.*

half-routing Two remote AppleTalk networks using the DialUp access method to communicate over a point-to-point link, forming a wide area internet. See also *point-to-point link* and *wide area internet.*

half-routing link A type of point-to-point link, consisting of two half-routers connected to modems communicating over a standard telephone line or a leased line. See also *point-to-point link.*

half-routing port A port that uses the DialUp access method, allowing an internet to connect to a remote network. See also *remote network.*

hexadecimal A base 16 numbering system. In Router Manager, a *$* character must precede a hexadecimal number.

high-speed network A network that has a high transmission rate, such as an Ethernet or Token Ring network. See also *transmission rate.*

hop The unit by which the routing distance between two networks in an internet is measured. Each hop corresponds to a router through which a data packet must pass as it traverses the path from one network to the other. See also *routing distance.*

hop count The number of routers through which a packet must pass to reach its destination network. The maximum hop count is 15 hops.

hop-count reduction On a half-routing or tunneling port on which network-number remapping is enabled, allowing routing distances greater than 15 hops. When hop-count reduction is enabled on a port, all networks accessible out that port appear to be one hop away from all AppleTalk networks in the router's local internet. This allows the creation of larger internets.

hop-count weighting On a slow half-routing or tunneling port, increasing the routing distance through the port by a specific number of hops.

host In a network, a central or controlling computer that provides supporting services, such as computation, database access, or special programs, to multiple users.

host ID Either a TCP/IP host address that has the format *###.###.###.###*, in which each group of three numbers has a value between 0 and 255, or a TCP/IP host name that does not begin with a number.

host list A list of host computers connected to an IP tunneling port.

internet Two or more networks, of the same type or different types, that are connected by routers, allowing them to communicate and share network services. See also *network.*

internet routing An internet router receiving packets from devices on the internet, then forwarding them to their destinations over the most efficient path.

IP address A unique identifier assigned to a host on a TCP/IP internet.

IP Tunnel An AppleTalk connection or access method that uses AppleTalk protocols to communicate through a tunnel built on a TCP/IP network. See also *access method* and *AppleTalk connection.*

kilobits per second (Kbps) A unit of measurement for the data transmission rate that is characteristic of a LocalTalk network.

Kbps Acronym for *kilobits per second.*

LAN Acronym for *local area network.*

leased line A private telephone line leased from a telephone company.

link See *half-routing link* and *point-to-point link.*

local area network (LAN) A network that consists of computers and shared devices connected by one type of media, at a single location. See also *network.* Compare *wide area network.*

local internet An AppleTalk internet comprising all connected networks that are administrated by the same network administrator, and are not accessed through half-routing or tunneling ports. See also *half-routing port, internet,* and *tunneling port.*

local network An AppleTalk network connected directly to an Apple Internet Router.

LocalTalk An AppleTalk connection or access method for the printer, modem, or other serial port. See also *access method, AppleTalk connection,* and *LocalTalk network.*

LocalTalk cable A shielded twisted-pair cable that generally connects a LocalTalk network to the printer port on a Macintosh computer and allows a maximum of 32 devices on a single network configured in a bus topology. See also *printer port.*

LocalTalk network A type of AppleTalk network that uses the connection software and hardware built into a Macintosh computer, provides a transmission rate of 230.4 Kbps, supports bus or star topologies, and uses various types of media. See also *AppleTalk network.*

LocalTalk port A physical port to which a LocalTalk network is connected. See also *port.*

loop See *routing loop.*

lower-speed network A network that has a low to moderate transmission rate, such as LocalTalk network. See also *transmission rate.*

Macintosh startup The process of starting up a Macintosh computer. Compare *router startup.*

MacTCP driver A program installed in the Extensions folder that implements TCP/IP on a Macintosh computer.

media Electrical cables, fiber-optic cables, or other physical conductors that transmit data between devices on a network.

megabits per second (Mbps) A unit of measurement for a data transmission rate that is characteristic of an Ethernet or Token Ring network.

Mbps Acronym for *megabits per second.*

modem A contraction of *modulator/demodulator.* A device that connects a computer or network to another computer or network over a standard telephone line or a leased line.

modem port On the back panel of a Macintosh, the socket indicated by a telephone icon, to which you can connect a modem or a LocalTalk network. This serial port has a higher interrupt priority than the printer port. See also *LocalTalk network* and *printer port.*

Name Lookup A process that binds the names of network devices to their network addresses.

Name Request A process that requests the names of network devices to be included in device lists.

native internets Internets that communicate using the same protocol family.

network A group of interconnected, individually controlled computers and peripheral devices, and the hardware, media, and software that connect them. A network allows users to communicate and share network services—such as printers and file servers.

network activity See *traffic.*

network address An identifier for an AppleTalk network—a network number for a LocalTalk network or a network range for any other type of AppleTalk network—that must be unique in an internet. See also *network number* and *network range.*

network administrator A person who is responsible for setting up, maintaining, and troubleshooting a network.

network connection The physical media connecting devices in a network. See also *media.*

Network control panel In the Control Panels folder, a program that allows an administrator to select the AppleTalk connection and zone for a Macintosh. See also *AppleTalk connection* and *zone.*

network hiding Providing basic network-level security on a wide area internet by hiding a specific AppleTalk network from a half-routing or tunneling port on that router.

network information The network number or network range and zone name or zone list for a port. See also *network number, network range, zone list,* and *zone name.*

network list A list of networks to be hidden.

network number A decimal or hexadecimal number that uniquely identifies a LocalTalk network. Compare *network range.*

network-numbering conflict A conflict that results when two different networks on an internet have the same network number or range, or have overlapping network ranges.

network-number remapping On a half-routing or tunneling port, the automatic assignment by the router of remote network numbers to a different range of network numbers to resolve numbering conflicts. See also *clustering* and *network number.*

network range A range of contiguous network numbers that uniquely identifies each EtherTalk or TokenTalk network on an AppleTalk internet. Compare *network number.*

network service A shared resource to which a network provides access. Network services include shared peripheral devices—such as printers and file servers—shared files on network devices, and electronic mail systems. See also *file server* and *server.*

network system A family of network components—including computers, shared peripheral devices, and the hardware and software that connect them—for a specific network type or for networks that use a specific protocol family, such as AppleTalk or TCP/IP. See also *protocol family.*

network interface card An expansion card that provides one or more physical ports for a specific type of network, and is installed in a NuBus™ expansion slot or in a processor direct slot.

network type One of the various kinds of networks that can use AppleTalk protocols, including LocalTalk, Ethernet, and Token Ring. Network types have different transmission rates, support different types of media and topologies, and use different AppleTalk connections.

next router A router on the path to a destination network to which a forwarding port transmits packets. See also *forwarding port* and *router.*

node An addressable computer or other device on an AppleTalk network. See also *device.*

node ID Abbreviation for *node identifier.*

node identifier (node ID) A number between 1 and 254 that with a device's AppleTalk network number uniquely identifies that device on an AppleTalk network.

nondedicated router A router running on a computer that provides concurrent network services or on which another application program is running. Compare *dedicated router.*

nonseed port A port configured to obtain a connected network's identifying information—including its network number or network range and zone name or zone list—from a seed router connected to that network. Compare *seed port.*

nonseed router A router that obtains the network number or network range and the zone name or zone list for a connected network from a seed router connected to that network. Compare *seed router.*

packet A single unit of data that is formatted for transmission over a network and includes control elements, such as a source address and a destination address.

partially connected tunnel A tunnel on which some exterior routers cannot communicate with some other exterior routers connected to the tunnel. Compare *fully connected tunnel.* See also *tunnel.*

password See *administrator's password* and *caller's password.*

path A route over which a packet travels when one device transmits data to another device on a network. When one or more routers are present on an internet, a route over which one router forwards data to the next router until it reaches its destination. See also *redundant paths.*

peripheral device A unit of hardware connected to and controlled by a computer—such as a printer, modem, video monitor, or disk drive.

physical port See *port.*

point-to-point link A communications path between two routers that may consist of modems communicating over a standard telephone line or a leased line. See also *modem.*

port A socket on the back panel of a computer or on a network interface card into which you can plug a cable that physically connects a network or a peripheral device. See also *modem port* and *printer port.*

port configuration The port information specified for a port in a setup document.

port description An administrator's description of the network connected to a port. By default, the name of the physical port.

port statistics Statistical information for each port configured on the router and totals for the router, about the levels of traffic on a port and the numbers of errors that occur on the network or internet connected to a port.

port status The current condition of a port—either active or inactive.

Preferences folder A folder in the System Folder that contains files that store user-specified preferences for application programs.

primary path Where redundant paths exist, the path between two internets that a router typically uses. Compare *backup path.* See also *path* and *redundant path.*

printer port On the back panel of a Macintosh, the socket indicated by a printer icon, to which you can connect a printer or a LocalTalk network. This port is a serial port. See also *modem port.*

protocol A standard set of rules that govern the sending and receiving of information over data communication lines.

protocol family A set of protocols that govern data communication on a specific network system—such as AppleTalk or TCP/IP. See also *AppleTalk* and *TCP/IP.*

redundant paths Two or more paths that connect a pair of devices communicating on an internet. See also *path.*

remapping See *network-number remapping.*

remapping range On a half-routing or tunneling port, a range of network numbers that is reserved for use when remapping network numbers for networks accessible through that port. See also *network-number remapping.*

remote network A network at another site that is connected to the router by a point-to-point link. See also *point-to-point link.*

repeater A device that extends the maximum length of cable in a single network.

ring A type of network topology in which cables connect devices in a closed loop. See also *topology.*

route To forward packets received from devices on a network to their destinations over the most efficient path.

router A device that connects two or more AppleTalk networks of the same type or different types—for example, a LocalTalk and a Token Ring network—isolating traffic within each network. When a router receives data from devices on the network, it forwards the data to its destination over the most efficient path available.

router extension Software that extends the capabilities of the Apple Internet Router.

Router Installer A program that installs the router software on the startup disk in a Macintosh that will be used as a router.

Router Log A document that contains a record of router operations, including port status, and errors that occur at startup or during router operation.

router Macintosh A Macintosh computer on which a router is installed or running.

Router Manager An application program that allows an administrator to set up the router and configure its ports, control and troubleshoot router operation, and monitor router performance.

router name An identifier that an administrator assigns to a router Macintosh.

router port A physical port and the access method that a router uses to communicate with a network connected to one of its ports. See also *access method* and *port.*

router startup The process of starting the router. Compare *Macintosh startup.*

router statistics Statistical information for the router about the number of packets routed, and the levels of network activity, network reliability, and errors occurring on the internet.

router status indicator In the Network control panel, an indication of the router's current status—on or off.

routing distance The distance in hops between two networks, or the number of routers through which a packet must pass to reach its destination network.

routing loop A condition that exists when a router sends packets that return to the router through a redundant path. Compare *redundant paths.*

routing table Routing information that is maintained by the router for each destination network on an internet, specifying its network number or range, routing distance, forwarding port, and next router.

routing table entry Routing information maintained by the router for a single network on an internet, including its network number or range, routing distance, forwarding port, and next router. See also *routing table.*

routing traffic Network traffic caused by sending routing information. See also *traffic.*

script A program that controls the operation of the Router Installer software or a modem.

seed port A port configured with a network number or network range and a zone name or zone list for a connected network. Compare *nonseed port.*

seed router A router on which you specify a network number or network range and a zone name or zone list for a network when configuring the port to which that network is connected. A seed router sends a network's identifying information to all other routers connected directly to that network. Compare *nonseed router.*

serial port A port through which computers and peripheral devices communicate data serially—one bit at a time. The modem port and printer port are serial ports on the back panel of a Macintosh to which you can connect a modem, a printer, or a LocalTalk network. See also *modem port, port,* and *printer port.*

server A computer that provides network services—such as file or print services. See also *file server.*

service See *network service.*

setup document A file created in Router Manager that identifies the router and defines the router's port configurations. See also *port configuration.*

setup window In Router Manager, a window that displays an overview of the information for ports configured in a setup document.

shared disk A hard disk or CD-ROM disc connected to a computer on a network, which contains files that users at other computers on the network can access.

Simple Network Management Protocol (SNMP) An industry-standard protocol that allows an administrator to manage devices on a complex multivendor network.

SNMP Acronym for *Simple Network Management Protocol.*

SNMP agent Software that allows an administrator working at a remote computer to obtain statistical and other information from the router.

star A type of network topology in which all devices are connected to a central controlling device, or hub. See also *topology.*

startup See *Macintosh startup* and *router startup.*

startup document The setup document that the router uses at startup. See also *router startup* and *setup document.*

startup options Options that either control router startup or take effect at startup. See also *startup document.*

star-wired ring A type of network topology in which each device on a Token Ring is connected to a central wiring

concentrator called a multistation access unit (MAU). See also *ring, Token Ring,* and *topology.*

T-connector A type of connector that plugs into an Ethernet port on a computer, which must have either a thin coaxial Ethernet cable or a terminator plugged into each side of the connector.

TCP/IP Acronym for *Transmission Control Protocol/Internet Protocol.* A family of protocols that allows the interconnection of various types of computers in a local or wide area network. TCP controls data transmission and IP controls routing. See also *protocol.*

TCP/IP network A network that communicates using the TCP/IP family of protocols.

terminator An electronic resistance device installed at either end of a bus network. The Apple Ethernet Thin Coax Transceiver and Apple Ethernet cables have built-in terminators. Also referred to as a *terminating resistor.*

thin coaxial cable A type of coaxial cable that has a $^{3}/_{16}$-inch diameter and connects the devices on an Ethernet network in a bus topology. Also referred to as *thinnet.* See also *coaxial cable.*

token A special type of data packet that one device on a Token Ring passes to another device, to control access to the network. A device can transmit data on the network only when it possesses the token.

Token Ring A widely used type of network that provides transmission rates of 4 or 16 Mbps, uses shielded or unshielded twisted-pair cable, and has a star-wired ring topology. Token passing controls access to the network. See also *token.*

Token Ring port A physical port to which a Token Ring network is connected. See also *port.*

TokenTalk An AppleTalk connection that allows a Token Ring network to use AppleTalk protocols. See also *AppleTalk connection.*

topology The physical layout of devices and cables in a network. See also *bus, ring, star,* and *star-wired ring.*

traffic The volume of data packets generated by devices communicating over a network connection or through a device.

transceiver A device that transmits and receives data, and allows a computer to connect to a specific type of media. See also *media.*

transmission rate The speed at which a network can transfer data.

troubleshooting The process of defining a problem's cause and isolating its source, then solving the problem.

tunnel A virtual data communications link that allows networks or internets using the same protocol family to communicate with one another through a foreign network system that uses a different protocol family, or a half-routing link. See also *foreign network system* and *half-routing link.*

tunneling Two or more AppleTalk networks or internets communicating through a tunnel built on a foreign network system, generally forming a wide area internet. See also *foreign network system, tunnel,* and *wide area internet.*

tunneling port A port that is configured for tunneling and uses an access method for a foreign network system to provide wide area connectivity between two or more internets.

user port The AppleTalk connection for nonrouting services available on the Macintosh when the router is running, which determines the zone in which the router Macintosh and any network services residing on that Macintosh appear in the Chooser. See also *AppleTalk connection* and *zone.*

WAN Acronym for *wide area network.*

wide area internet An internet that consists of computers and shared devices at remote locations connected by a half-routing link or tunnel.

wide area network (WAN) A network that consists of computers and shared devices at remote locations connected by a half-routing link or tunnel. Compare *local area network.*

wildcard A typographic character that signifies "all possible values" in the the names of devices, device types, routers, and zones.

X.25 An access method for a physical port that corresponds to an Apple Serial NB Card installed in the router Macintosh, which allows the port to function as a half-routing port. Also, the CCITT (Consultative Committee for International Telephony and Telegraphy) standard protocols and message formats for packet-switching networks. See also *access method* and *protocol.*

X.25 network A packet-switching network in which routers communicate over point-to-point links using X.25 protocols. A type of wide area network. See also *point-to-point link.*

zone A logical grouping of devices on an AppleTalk internet that facilitates access to shared network services. A network administrator defines the zones in an internet when setting up the router. Each device on the internet resides in a zone. To access a device in the Chooser, you must first select the zone in which the device resides.

zone list A list of one or more zone names defined for any type of AppleTalk port other than a LocalTalk network—for example, an EtherTalk or TokenTalk network. A user can assign a device on a network to any zone listed for that network.

zone name An identifier for the single zone defined for a LocalTalk network or one of the names in a zone list.

zone table Zone information maintained by the router for each destination network on an internet, mapping network numbers to zone names and network ranges to zone lists.

zone table entry Zone information maintained by the router for a single network on an internet, including its zone name or zone list.

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